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Electronic Business®

FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

JULY 24, 1989

THE TOP 200 U.S. ELECTRONICS COMPANIES

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Will Amphenol wake up? PAGE 66

Venture capitalists play it safe PAGE 76

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES — WORLDWIDE

VOL. 15, NO. 15 JULY 24, 1989

COVER STORY/THE ELECTRONIC BUSINESS 200

24 Top line rises 9.5%, but the bottom line falls 3.2%

Results of the exclusive ELECTRONIC BUSINESS 200 show that 1988 generally was an upbeat year on the sales front for U.S. electronics and computer companies — but nonetheless it was a year rife with disturbing financial indicators. Total sales grew to $327.7 billion in 1988 from $299.2 billion in 1987. But the improvement in sales may be deceiving because the increase comes almost exclusively from foreign markets. In fact, foreign sales of the 200 rose 42.1%, while U.S. sales were up only 2.4% — suggesting that the domestic economy is slowing down for these companies.

PAGE 26 Vibrant foreign sales can't mask discouraging indicators

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17 After AT&T, Olivetti eyes U.S. vertical markets

Olivetti has formulated a new strategy for penetrating U.S. markets that coincides with a recent company-wide restructuring. In an interview, managing director Vittorio Cassoni says the Italian computer maker will focus on three U.S. vertical markets — banking, retail and government.

THE ELECTRONIC BUSINESS 200

24 Top line rises 9.5%, but the bottom line falls 3.2%

The ELECTRONIC BUSINESS 200, gleaned from countless annual reports, 10-K filings, exclusive interviews and internal estimates, offers a detailed view of last year's performance by electronics companies at the top of the heap. It also provides insight into the direction of the U.S. electronics industry. What the figures show is not encouraging.

26 Vibrant foreign sales can't mask discouraging indicators

The U.S. electronics industry isn't exactly sick. But according to the 1988 ELECTRONIC BUSINESS 200, its vital signs indicate a financial weakness that foretells problems. While total sales grew by 9.5%, net income fell 3.3%.

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Venture capital has been bitten by the LBO bug, and that is bad news for electronics entrepreneurs who are seeking early- or middle-stage financing. Stung by declining investment returns on their earlier stage deals, some venture capitalists have turned to backing established high-tech companies as a way to reduce risk and speed paybacks.

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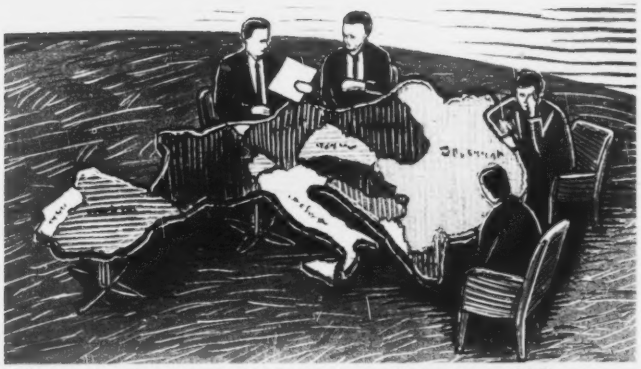
Skoloff/Wendell/Raynor



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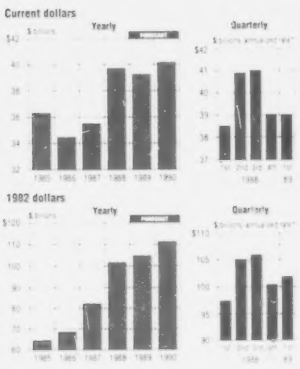

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EUROPE BUSINESS

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Walls — in the name of standards — are going up around Fortress Europe. An EC committee is determining the technical product standards that will apply throughout Europe after its unification in 1992 — all without the input of Americans. The fear among U.S. manufacturers is that they will lose access to Europe.

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Ready or not, Japan's big electronics exporters have become multinational companies. Scrambling to counter the high yen, major Japanese electronics companies have moved some 15% to 30% of their total production offshore in the past several years. With a workforce 30% to 50% non-Japanese, the task now is to make it work.

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The 200

Every organization has its benchmarks by which it measures continued success and effort. Apple has its Mac, and Motorola its 68000 microprocessor. And it's a big deal in the sports world when a Roger Clemens wins 20 games.

We, too, at ELECTRONIC BUSINESS have a standard, and that's the ELECTRONIC BUSINESS 200, our exclusive annual ranking of the top 200 publicly held electronics, computer and systems companies in the country. The ELECTRONIC BUSINESS 200 is a compilation of everything that we do here and, we hope, everything that we do well. The listings we give throughout the year — such as the fastest-growing or most profitable companies — are all signs that lead to the 200.

The process of producing the 200 is a yearlong one for senior editor Linda Stallmann, who laboriously tracks, collects, sorts, analyzes and charts hundreds of annual reports, 10-K filings and company press releases. Linda's research comes to a head around May, when various trends begin to emerge. For example, this year's 200 listing shows a rising top line, but a falling bottom line. And falling profits in 1988, Linda says, portend some discouraging financial problems on the horizon.

Bruce Rayner

Our listing is buttressed by many pieces of information. Linda and fellow senior editor Bruce Rayner have penned an introduction that sums up some of the major trends, such as the 42% increase in foreign sales. Further analysis comes by way of "Facts behind the Figures," "Rankings by Industry Segment," and "Best and Worst Performers."

As in previous years, the 200 is also available on disk (both IBM compatible Lotus 1-2-3 and Apple Macintosh Excel versions). The cost is $100. For three years of the 200 (covering 1986, 1987 and 1988), the cost is $200. To order, please write assistant editor Xiong Xiaoge, ELECTRONIC BUSINESS, Cahners Building, 275 Washington St., Newton MA 02158, or call him at (617) 558-4230.

Linda Stallmann

MARVIN GREENE, section editor

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BPA ABP

The top line rises 9.5%, but the bottom line falls 3.3%

The ELECTRONIC BUSINESS 200, compiled over several months by senior editor Linda Stallmann, is an exclusive report that analyzes the financial statements of the 200 largest, publicly held electronics, computer and systems manufacturers based in the United States. The intent of our research is to provide an accurate gauge of the current status—and future direction—of the industry. In capsule, 1988 was an upbeat year on the sales front for the U.S. electronics industry, but nonetheless a year rife with disturbing financial indicators.

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Vibrant foreign sales can't mask discouraging indicators

While foreign sales for the 200 flourish, U.S. sales and total profits flounder. Two other key indicators — return on investment and return on equity — are both down

BY LINDA STALLMANN AND BRUCE C.P. RAYNER

The U.S. electronics industry isn't exactly sick. But according to the 1988 ELECTRONIC BUSINESS 200, an exclusive annual listing of the top 200 public electronics companies in the country, its vital signs indicate a financial weakness that foretells chronic problems.

The ELECTRONIC BUSINESS 200, gleaned from countless annual reports, 10-K filings, exclusive interviews and internal estimates, gives a glimpse into last year's performance by electronics companies at the top of the heap. It also provides insight into the direction of the U.S. electronics industry.

What the figures show is not encouraging.

Sure, total sales grew 9.5% to $327.7 billion in 1988, up from $299.2 billion in 1987. That rates as the best growth since the boom year of 1984, when annual growth measured a healthy 13.4%. But the improvement in sales is deceiving, since they come almost exclusively from foreign markets. In fact, foreign sales of the ELECTRONIC BUSINESS 200 rose 42.1%, while U.S. sales were up only 2.4% — suggesting that the domestic economy is slowing down for these companies.

The reason? A maturing U.S. market and stiff foreign competition from Japan and Europe. The top U.S. electronics companies, most of them transnationals, are focusing more and more on growing foreign markets across both the Pacific and Atlantic oceans. In particular, they are scrambling to get into Europe by the end of 1992, when intra-European trade barriers will come down.

IBM: 4.4% profits increase

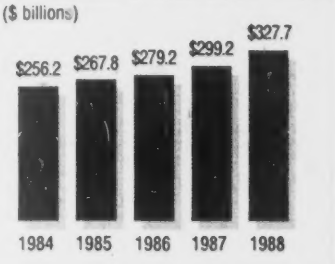
Indicative of this trend is IBM, the top performer on the ELECTRONIC BUSINESS 200 since it was first published in 1978. In 1988, IBM posted total sales growth of 8%, with overseas sales of $34.4 billion and growing at a rate of 15.5%. Big Blue's U.S. sales, however, slipped marginally to $25.3 billion from $25.5 billion in 1987. IBM's 1988 profits accentuate the trend set by sales: up by 22.3% in foreign markets, down by 27.3% in the United States, for a total net profit increase of 4.4% (before the effect of an accounting change).

IBM's overall profit growth is an exception to the rule. Net income for the top 200 U.S. electronics companies fell by 3.3%, after logging a stellar 53.7% growth in 1987. This year's poor performance makes it three out of the last five years that the ELECTRONIC BUSINESS 200 listing has posted negative profit growth. True, it is hard to follow up a year like 1987, but the wild swings since 1984

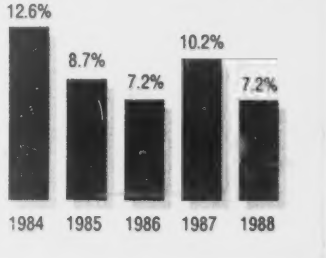
Composite performance of the ELECTRONIC BUSINESS 200

	1984	1985	1986	1987	1988
Electronics sales ($ billions)	$256.2	$267.8	$279.2	$299.2	$327.7
Total sales ($ billions)	$776.5	$797.8	$641.7	$689.7	$774.5
Total net income ($ billions)	$46.4	$35.4	$26.7	$41.0	$39.7
WEIGHTED AVERAGES	**1984**	**1985**	**1986**	**1987**	**1988**
Return on equity	16.5%	11.8%	10.2%	14.1%	13.1%
Return on investment	12.6%	8.7%	7.2%	10.2%	7.2%
Cost of goods sold/sales	69.4%	70.3%	63.7%	61.5%	58.6%
R&D/sales	4.2%	4.2%	5.0%	5.2%	5.1%
Sales per employee	$103,200	$110,800	$102,348	$113,533	$128,756
Net income per employee	$6,300	$5,000	$4,266	$6,662	$6,646
5-year compound annual growth					
Sales	+8.5%	+5.0%	+8.2%	+10.7%	+11.5%
Net income	+11.6%	+1.4%	+4.0%	+13.9%	+8.3%
Capital outlay to net cash flow after dividends	96.0%	118.3%	97.9%	73.9%	83.8%
Debt/total capital	23.5%	26.7%	29.9%	28.2%	45.3%
Foreign sales/total sales	—	14.0%	25.4%	24.9%	31.5%

Electronics sales



Return on investment



have serious implications for the industry's long-term health.

In total, 28 of the ELECTRONIC BUSINESS 200 are red-ink companies in 1988, up from 23 in 1987. No. 2 AT&T stands out from the pack with a net loss last year of $1.67 billion, a result of a $6.7 billion equipment write-off. Similarly, Honeywell Inc., ranked 10th, posted a net loss of $434.9 million due to military-contract losses and restructuring. Other heavy losers include Combustion Engineering Inc., Cullinet Software Inc. (which competitor Computer Associates Inc. recently agreed to buy), LTV Corp. and Sundstrand Corp.

Lower profits mean fewer investments from retained earnings in the future. A sign of this is the five-year figures for capital outlays made from net-cash flow — a gauge of capital investment and an indicator of competitiveness. When profits go up, capital outlays go up, usually with a lag of one year. Last year was no exception. As a result of '87 profits, '88 capital outlays rose to 83.8% of net-cash flow, up from 73.9% in 1987.

That's usually a good sign. But for three years in a row, this figure has been less than 100%. As a rule of thumb, anything less than 100% implies a capital base being compromised for short-term profit. In the capital-intensive, cutthroat electronics industry, this is indeed cause for concern. And with falling profits this year, the industry can look for even smaller percentages next year.

ROI, ROE both drop

Other financial indicators give rise to concern, too. Both return on investment and return on equity declined last year. ROI at 7.2% was down from 10.2% in 1987. Similarly, ROE dropped from 14.1% in 1987 to 13.1% in 1988. Both of these figures give credence to Wall Street's opinion that electronics — especially the semiconductor field — is losing its investment appeal.

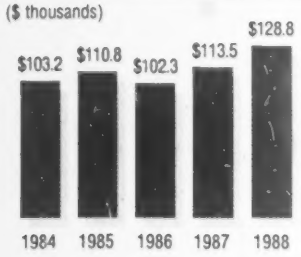
Foreign sales of the ELECTRONIC BUSINESS 200 rose 42.1%, while U.S. sales were up only 2.4%

But, of course, aggregation masks individual performance. This year's list had its share of successes. Micron Technology Inc., for example, the Idaho-based DRAM maker, came from nowhere to nab the 107th position in 1988. The company rode the DRAM shortage to capture sales of $368 million for calendar year 1988, up from $116 million in 1987.

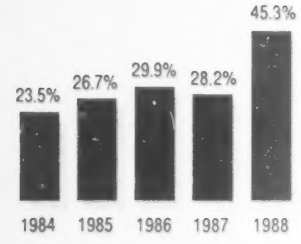
In all, this year's list has 22 new entrants. Most of these additions replaced companies that went private or were acquired. In fact, only seven of the 22 that fell off the list did so because of inadequate sales growth. Notable departures include Computervision Corp., acquired by Prime Computer Inc., itself a target of a hostile takeover bid; Convergent Inc., bought by Unisys Corp.; Gould Inc., sold to Nippon Mining Co. Ltd.; and The Singer Co., bought by corporate raider Paul Bilzerian.

Restructuring has its upside and its downside. It has meant a more productive industry, with sales per employee coming in at a strong 13.4% growth rate in 1988, up from 10.9% in 1987. But it has also meant a growing debt burden. For the ELECTRONIC BUSINESS 200, debt as a percentage of total capital shot up by 60.6% last year and is now up to a dangerous and unprecedented 45.3%. The consequences could be severe if the economy heads south later this year, as many financial experts predict. □

Sales/employee



Debt/total capital



Notes to the ELECTRONIC BUSINESS 200

Revenue (sales)
Revenue includes sales of products, services and rentals, but excludes dividends, interest and other non-operating revenue.

Profit
Profits are shown after taxes from continuing operations and before extraordinary items.

Return on equity
ROE is profits as a percentage of shareholders' equity (preferred stock, capital stock, surplus and retained earnings at the company's year-end).

Return on investment
ROI is profits as a percentage of shareholders' equity plus short-term debt and long-term debt. Short-term debt includes the current portion of long-term debt, notes payable and other borrowings.

Cost of goods sold
This includes manufacturing costs of products, services and rentals sold, less depreciation as a percentage of revenue.

Research and development
R&D is company-sponsored research and development expenses as a percentage of revenue.

Employees
The number of employees is supplied by each company. In most cases this number represents year-end employment.

Capital expenditures to net cash flow
Capital expenditures are measured as a percentage of net profits from continuing operations plus depreciation, minus cash dividends paid.

Debt to total capital
This includes long-term debt plus short-term debt as a percentage of shareholders' equity and long- and short-term debt.

Foreign sales
These include sales of operations outside the United States to unaffiliated customers and U.S. operations' export sales.

THE ELECTRONIC BUSINESS 200

FINANCIAL TABLES: 1-50

Rank 1988	Rank 1987	Company	Calendar year 1988 Electronics revenue ($ millions)	Calendar year 1988 Total revenue ($ millions)	Calendar year 1988 Net income ($ millions)	Fiscal year 1988 Total revenue ($ millions)	Fiscal year 1988 Net income ($ millions)	Return on equity	Return on investment
1	1	IBM	$59,681	$59,681.0	$5,491.0	$59,681.0	$5,491.0	13.9%	10.4%
2	2	AT&T	14,377	35,210.0	-1,669.0	35,210.0	-1,669.0	-14.6%	-8.1%
3	4	Digital Equipment	12,285	12,284.7	1,209.2	11,475.5	1,305.6	17.4%	16.8%
4	3	GM Hughes Electronics	11,244	11,243.6	634.6	11,243.6	634.6	8.4%	7.4%
5	7	Xerox[1]	11,152	11,476.0	73.0	11,476.0	73.0	6.8%	2.9%
6	8	Hewlett-Packard	10,296	10,296.0	830.0	9,831.0	816.0	18.0%	16.0%
7	5	Unisys	9,902	9,902.0	680.6	9,902.0	680.6	13.7%	8.0%
8	6	General Electric	9,300	40,292.0	3,386.0	40,292.0	3,386.0	18.3%	12.8%
9	9	Motorola	8,250	8,250.0	445.0	8,250.0	445.0	13.2%	9.4%
10	10	Honeywell	7,148	7,148.3	-434.9	7,148.3	-434.9	-25.1%	-15.3%
11	12	Texas Instruments	6,295	6,295.0	336.0	6,294.8	366.3	16.3%	12.7%
12	11	NCR	5,990	5,989.9	439.3	5,989.9	439.3	19.6%	16.1%
13	14	Raytheon	4,994	8,192.1	489.6	8,192.1	489.6	23.1%	15.9%
14	15	Eastman Kodak	4,830	17,034.0	1,397.0	17,034.0	1,397.0	20.6%	8.4%
15	16	Rockwell International	4,593	12,133.8	779.0	11,946.3	811.9	22.0%	17.5%
16	13	Lockheed	4,554	10,590.0	442.0	10,590.0	442.0	17.9%	12.9%
17	22	Apple Computer	4,434	4,434.1	419.3	4,071.4	400.3	39.9%	35.4%
18	17	Tandy	3,992	3,992.3	321.3	3,793.8	316.4	19.7%	15.3%
19	26	Control Data	3,628	3,628.3	1.7	3,628.3	1.7	0.2%	0.1%
20	24	Ford Motor	3,350	92,445.6	5,300.2	92,445.6	5,300.2	24.6%	5.8%
21	20	Litton Industries	3,326	4,942.4	172.0	4,863.9	167.0	14.2%	6.1%
22	21	Wang Laboratories	3,075	3,074.5	50.3	3,068.4	92.7	5.8%	4.1%
23	23	Martin Marietta	3,058	5,727.5	319.8	5,727.5	319.8	26.6%	18.9%
24	25	3M	3,000	10,581.0	1,154.0	10,581.0	1,154.0	20.9%	18.4%
25	35	Intel	2,875	2,874.8	452.9	2,874.8	452.9	21.8%	16.3%
26	19	TRW	2,842	6,982.0	261.0	6,982.0	261.0	16.7%	10.2%
27	18	Allied-Signal	2,750	11,909.0	463.0	11,909.0	463.0	14.2%	8.3%
28	29	Zenith Electronics	2,686	2,685.7	5.3	2,685.7	5.3	1.1%	0.6%
29	28	Westinghouse Electric	2,672	12,499.5	822.8	12,449.5	822.8	21.7%	6.5%
30	36	National Semiconductor	2,667	2,666.8	-18.1	2,469.7	62.7	6.2%	5.9%
31	27	ITT	2,539	19,355.0	858.0	19,355.0	817.0	10.2%	5.4%
32	32	Du Pont	2,300	32,917.0	2,190.0	32,917.0	2,190.0	14.1%	10.5%
33	34	AMP	2,269	2,669.7	319.1	2,699.7	319.1	21.0%	18.3%
34	33	Boeing	2,231	16,962.0	614.0	16,962.0	614.0	11.4%	10.8%
35	39	Emerson Electric	2,200	6,793.1	540.7	6,651.5	528.8	18.8%	14.5%
36	30	Harris	2,105	2,104.8	69.6	2,099.3	65.4	6.7%	5.8%
37	47	Compaq Computer	2,066	2,065.6	255.2	2,065.6	255.2	31.3%	23.4%
38	31	Pitney Bowes	2,020	2,649.9	237.0	2,649.9	237.0	18.7%	6.5%
39	38	GTE	2,000	16,459.9	1,224.7	16,460.0	1,177.0	12.4%	5.6%
40	41	Amdahl	1,802	1,801.8	213.8	1,801.8	213.8	21.2%	18.5%
41	37	McDonnell Douglas	1,800	15,072.0	350.0	15,072.0	350.0	11.0%	5.1%
42	42	Avnet	1,718	1,938.3	50.6	1,829.3	52.2	7.5%	5.7%
43	58	Prime Computer	1,595	1,594.6	13.0	1,594.6	13.0	2.4%	1.8%
44	65	Sun Microsystems	1,462	1,461.6	89.6	1,051.6	66.4	18.0%	12.6%
45	44	Tektronix	1,431	1,431.0	-8.6	1,411.9	-16.7	-3.4%	-2.3%
46	52	Tandem Computers	1,425	1,424.7	102.1	1,314.7	94.5	11.0%	9.5%
47	53	Seagate Technology	1,351	1,351.0	-5.5	1,257.0	77.3	17.7%	10.4%
48	45	Data General	1,331	1,330.5	-48.8	1,364.7	-15.5	-2.5%	-2.2%
49	59	Chrysler	1,300	31,884.2	1,050.2	31,884.2	1,050.2	13.9%	3.0%
50	54	E-Systems	1,298	1,439.0	74.6	1,443.1	74.6	15.2%	12.5%

NA = not available
NM = not meaningful

[1] Xerox data is for business products and systems only, except for ROE, ROI, capital expenditures to net cash flow and debt to total capital

Fiscal year 1988				Five-year growth (Compounded average annual growth rate)					
Cost of goods as a percentage of revenue	R&D as a percentage of revenue	Revenue per employee ($ thousands)	Net income per employee ($ thousands)	Revenue	Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
35.0%	9.9%	$154.2	$14.2	5.4%	0.0%	70.5%	25.3%	57.6%	12/88
56.5%	7.3%	115.7	-5.5	NA	NA	539.3%	44.7%	0.0%	12/88
43.1%	11.4%	91.4	10.4	21.9%	35.7%	82.8%	3.6%	49.9%	6/88
70.7%	4.9%	115.9	6.5	NA	NA	55.7%	11.9%	12.3%	12/88
43.5%	6.9%	114.6	0.7	7.5%	NA	167.7%	58.1%	49.5%	12/88
44.3%	10.4%	113.0	9.4	15.9%	13.6%	57.9%	11.1%	51.6%	10/88
49.4%	7.2%	106.5	7.3	18.2%	28.2%	60.0%	41.7%	45.8%	12/88
67.9%	3.0%	134.3	11.3	7.8%	11.1%	51.7%	30.4%	39.0%	12/88
54.5%	8.1%	80.9	4.4	13.8%	12.8%	96.5%	29.0%	48.1%	12/88
71.9%	4.5%	91.2	-5.5	11.0%	NM	-136.0%	39.2%	22.9%	12/88
70.3%	7.8%	83.2	4.8	6.6%	NM	93.9%	22.4%	32.3%	12/88
48.5%	7.0%	99.8	7.3	9.9%	8.8%	66.1%	17.9%	58.3%	12/88
76.6%	3.3%	107.5	6.4	7.8%	9.7%	68.4%	31.0%	19.0%	12/88
49.4%	6.7%	117.2	9.6	10.9%	19.8%	96.7%	59.2%	43.9%	12/88
75.5%	3.6%	106.5	7.2	8.1%	15.8%	49.7%	20.4%	21.6%	9/88
NA	5.1%	122.0	5.1	11.5%	10.9%	52.5%	27.8%	11.1%	12/88
47.0%	6.7%	377.0	37.1	32.9%	44.2%	32.9%	11.3%	32.1%	9/88
47.5%	0.0%	102.5	8.6	11.1%	3.3%	28.1%	22.3%	1.8%	6/88
64.2%	9.3%	108.3	0.1	1.3%	-58.1%	86.6%	28.5%	29.8%	12/88
63.3%	3.2%	257.6	14.8	15.8%	23.2%	59.9%	76.5%	32.7%	12/88
74.2%	4.7%	88.4	3.0	4.2%	-7.8%	64.6%	57.0%	26.9%	7/88
40.3%	8.0%	99.3	3.0	14.8%	-9.4%	79.8%	29.4%	46.2%	6/88
78.8%	3.4%	86.8	4.8	12.2%	14.6%	73.7%	28.9%	0.0%	12/88
51.7%	6.5%	127.5	13.9	8.5%	11.6%	64.4%	12.0%	40.0%	12/88
45.0%	11.1%	138.2	21.8	20.7%	31.3%	71.9%	25.1%	42.9%	12/88
74.7%	5.1%	89.6	3.3	7.6%	7.5%	81.6%	38.6%	28.6%	12/88
77.2%	5.4%	108.7	4.2	5.5%	0.7%	98.7%	41.3%	35.3%	12/88
82.3%	3.7%	74.6	0.1	14.6%	-35.2%	68.0%	45.2%	17.9%	12/88
70.3%	5.7%	104.1	6.9	5.5%	12.9%	47.3%	69.8%	19.6%	12/88
63.3%	11.3%	65.5	1.7	15.3%	NM	85.5%	3.8%	45.2%	5/88
36.8%	2.7%	165.4	7.0	-0.9%	3.9%	46.6%	46.5%	28.6%	12/88
49.3%	4.0%	233.5	15.5	2.7%	14.2%	114.0%	25.4%	51.9%	12/88
56.1%	8.8%	112.0	13.2	12.2%	14.4%	59.6%	12.9%	53.6%	12/88
84.4%	4.4%	115.2	4.2	8.8%	11.6%	73.1%	4.6%	46.3%	12/88
63.2%	3.1%	93.9	7.5	11.8%	9.9%	44.7%	22.5%	28.1%	9/88
60.5%	5.6%	92.9	2.9	3.0%	0.5%	47.9%	13.2%	15.0%	6/88
57.3%	3.6%	299.4	37.0	79.4%	150.3%	89.9%	25.2%	38.6%	12/88
27.3%	3.0%	90.4	8.1	10.8%	15.8%	93.5%	65.2%	21.0%	12/88
61.3%	1.8%	103.5	7.4	6.1%	4.4%	109.0%	54.7%	14.7%	12/88
47.5%	12.3%	217.1	25.8	18.3%	37.7%	88.4%	12.5%	43.2%	12/88
77.6%	4.0%	124.1	2.9	8.9%	1.5%	98.9%	53.2%	21.8%	12/88
73.8%	0.0%	182.9	5.2	9.4%	0.7%	38.9%	24.6%	0.0%	6/88
40.7%	10.9%	128.7	1.0	25.3%	-16.8%	80.6%	25.3%	56.6%	12/88
47.5%	13.3%	148.3	9.4	161.2%	152.0%	100.0%	29.6%	38.4%	6/88
42.8%	15.3%	87.8	-1.0	3.5%	NM	164.9%	31.9%	44.4%	5/88
30.6%	12.9%	152.4	11.0	25.7%	25.1%	102.6%	14.0%	51.0%	9/88
78.0%	4.0%	41.9	2.6	62.7%	43.9%	221.7%	41.2%	40.5%	6/88
43.1%	12.1%	88.5	-1.0	10.5%	NM	116.6%	14.1%	46.0%	9/88
78.4%	2.8%	244.8	8.1	19.2%	28.3%	82.3%	78.2%	12.9%	12/88
63.1%	NA	86.3	4.5	13.2%	6.9%	57.6%	17.8%	10.4%	12/88

(Continued)

THE ELECTRONIC BUSINESS 200

FINANCIAL TABLES: 51-100

Rank 1988	Rank 1987	Company	Calendar year 1988 Electronics revenue ($ millions)	Calendar year 1988 Total revenue ($ millions)	Calendar year 1988 Net income ($ millions)	Fiscal year 1988 Total revenue ($ millions)	Fiscal year 1988 Net income ($ millions)	Return on equity	Return on investment
51	50	General Instrument	$1,268	$1,268.3	$84.3	$1,155.5	$66.2	12.0%	9.1%
52	56	Varian Associates	1,193	1,193.0	54.7	1,170.6	27.6	6.2%	5.5%
53	55	General Dynamics	1,180	9,551.0	379.0	9,551.0	379.0	19.7%	12.5%
54	57	Advanced Micro Devices	1,126	1,125.9	19.3	1,125.9	19.3	3.8%	2.7%
55	61	Loral	1,105	1,493.4	85.2	1,440.8	74.3	17.0%	7.3%
56	49	Northrop	1,087	5,797.1	-30.9	5,797.1	-30.9	-3.1%	-1.5%
57	46	Perkin-Elmer	1,078	1,200.7	63.7	1,165.5	60.0	8.3%	6.3%
58	43	United Technologies	1,050	18,000.1	659.1	18,000.1	659.1	13.7%	11.4%
59	77	Arrow Electronics	1,006	1,006.4	9.7	1,006.4	9.7	6.6%	3.4%
60	48	Teledyne	989	3,532.6	391.8	3,534.6	391.8	18.3%	14.5%
61	51	Grumman	985	3,648.9	86.5	3,648.9	86.5	10.5%	5.0%
62	76	Western Digital	973	972.9	48.3	768.3	43.0	16.9%	11.4%
63	74	Computer Associates	925	925.3	142.4	709.1	101.8	20.4%	16.4%
64	73	SCI Systems	900	900.1	20.3	777.7	19.0	12.5%	5.2%
65	62	Johnson Controls	881	3,227.2	104.6	3,099.6	103.5	12.1%	7.9%
66	66	Storage Technology	874	874.0	44.2	874.0	44.2	15.6%	7.4%
67	64	Eaton	860	3,468.5	227.7	3,468.5	227.7	19.7%	12.2%
68	71	Intergraph	800	800.2	88.0	800.2	38.0	13.2%	13.1%
69	70	General Signal	800	1,760.2	25.2	1,760.2	25.2	5.5%	2.6%
70	67	SmithKline Beckman	770	4,749.0	229.2	4,749.0	229.2	14.8%	7.8%
71	68	Cray Research	756	756.3	156.6	756.3	-156.6	23.1%	19.7%
72	63	Emerson Radio	722	721.7	5.3	728.8	-12.0	-15.3%	-5.1%
73	86	Microsoft	719	718.6	151.4	590.8	123.9	33.0%	31.3%
74	96	Emhart	700	2,762.5	126.6	2,762.5	126.6	13.0%	7.3%
75	78	Apollo Computer	654	653.5	0.2	653.5	0.2	0.1%	0.1%
76	72	Monsanto	647	8,293.0	591.0	8,293.0	591.0	15.6%	10.3%
77	101	MiniScribe	603	603.3	25.9	603.3	25.9	NA	NA
78	91	EG&G	600	1,406.3	68.7	1,406.3	68.7	20.7%	18.0%
79	69	Contel	595	2,963.7	311.6	2,964.0	312.0	19.8%	8.0%
80	105	LPL Investment Group	585	585.4	9.3	585.4	9.3	20.9%	1.7%
81	79	Medtronic	571	733.0	95.0	653.3	86.5	21.9%	19.0%
82	90	Molex	550	549.6	56.3	502.4	59.3	15.2%	14.9%
83	87	Raychem	529	1,102.7	102.8	1,094.7	125.3	17.3%	14.8%
84	81	Scientific-Atlanta	510	509.8	31.8	508.6	29.7	12.5%	12.3%
85	89	Sprague Technologies	505	504.6	13.2	504.6	13.2	4.0%	3.4%
86	108	Marshall Industries	495	494.5	21.7	420.4	17.6	29.0%	16.2%
87	95	Wyse Technology	489	488.7	-6.9	456.6	28.0	17.0%	9.9%
88	94	Lotus Development	469	468.5	58.9	468.5	58.9	25.4%	17.5%
89	99	Teradyne	462	462.3	-3.3	462.3	-3.3	-1.2%	-0.9%
90	122	AST Research	461	460.7	4.3	412.7	15.1	13.1%	8.1%
91	82	Atari	452	452.2	39.4	452.2	39.4	47.3%	22.3%
92	97	Analog Devices	452	452.1	41.1	439.2	38.0	11.1%	10.2%
93	109	MAI Basic Four	443	443.2	24.3	420.8	24.5	27.6%	8.2%
94	102	Dover	428	1,953.8	145.8	1,953.8	145.8	19.7%	14.7%
95	116	Mark IV Industries	410	569.7	22.7	403.0	17.0	18.4%	3.1%
96	107	Nashua	410	989.4	32.5	989.4	32.5	14.3%	10.2%
97	88	M/A-COM	409	409.3	16.3	424.2	18.4	8.5%	5.7%
98	126	AVX	409	408.9	27.6	408.9	27.6	13.2%	8.2%
99	162	Applied Materials	405	405.5	47.8	362.8	40.0	19.9%	18.0%
100	83	United Telecommunications	400	6,493.0	141.8	6,493.0	141.8	7.6%	2.5%

NA = not available
NM = not meaningful

Fiscal year 1988				Five-year growth (Compounded average annual growth rate)					
Cost of goods as a percentage of revenue	R&D as a percentage of revenue	Revenue per employee ($ thousands)	Net income per employee ($ thousands)	Revenue	Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
67.9%	3.2%	$75.0	$4.3	4.8%	-8.7%	46.2%	24.1%	10.8%	2/88
65.7%	6.9%	99.2	2.4	10.1%	-9.1%	69.2%	9.9%	40.2%	9/88
79.2%	4.3%	92.9	3.7	6.9%	6.2%	74.7%	36.5%	16.7%	12/88
45.2%	18.5%	59.5	1.0	25.7%	-1.6%	56.7%	27.5%	18.1%	12/88
56.9%	4.5%	105.2	5.4	36.0%	22.9%	38.6%	57.2%	11.2%	3/88
NA	3.6%	130.0	-0.7	12.2%	NM	165.6%	50.5%	0.0%	12/88
51.9%	8.5%	106.2	5.5	2.8%	3.6%	94.9%	24.7%	48.7%	7/88
71.9%	5.2%	96.4	3.5	6.2%	5.2%	88.1%	16.5%	46.2%	12/88
77.7%	0.0%	362.7	3.5	12.2%	13.8%	32.5%	48.0%	0.0%	12/88
73.8%	2.2%	80.7	8.9	3.5%	5.2%	151.1%	20.9%	10.7%	12/88
87.0%	0.5%	114.0	2.7	10.1%	-4.8%	72.5%	52.2%	4.8%	12/88
66.7%	8.8%	116.7	6.5	72.6%	96.3%	50.1%	32.4%	67.3%	6/88
48.4%	11.5%	158.7	22.8	64.9%	79.4%	11.8%	19.4%	39.4%	3/88
NA	0.0%	86.7	2.1	33.6%	23.6%	110.3%	58.3%	27.4%	6/88
77.6%	1.7%	107.3	3.6	18.5%	10.9%	115.2%	35.1%	16.9%	9/88
59.2%	7.7%	102.8	5.2	-0.3%	NM	35.7%	52.6%	32.5%	12/88
69.2%	3.5%	91.4	6.0	8.4%	23.6%	66.1%	37.8%	29.6%	12/88
43.4%	11.1%	109.6	12.1	26.0%	6.9%	54.3%	0.7%	28.7%	12/88
68.5%	6.6%	92.2	1.3	2.2%	-22.4%	106.5%	52.2%	25.8%	12/88
32.7%	10.4%	114.2	5.5	10.9%	-14.0%	135.2%	47.4%	44.5%	12/88
22.2%	15.6%	144.4	29.9	34.8%	43.1%	29.5%	14.9%	34.5%	12/88
93.3%	0.0%	1,041.2	-17.1	50.3%	NM	-75.4%	66.9%	0.0%	3/88
22.3%	11.8%	211.5	44.4	63.8%	80.4%	51.2%	5.1%	47.8%	6/88
65.9%	1.5%	83.7	3.8	10.4%	8.5%	62.7%	43.8%	37.0%	12/88
51.3%	11.8%	147.0	0.1	52.0%	-55.5%	141.7%	38.9%	56.6%	12/88
52.8%	7.8%	181.7	13.0	5.7%	9.9%	60.8%	34.1%	43.1%	12/88
NA	NA	NA	NA	NA	NA	NA	NA	NA	12/88
79.2%	1.4%	56.3	2.7	8.6%	7.9%	36.6%	12.9%	7.6%	12/88
24.5%	0.0%	128.9	13.6	5.4%	13.0%	129.8%	59.9%	0.0%	12/88
60.1%	1.6%	89.9	1.4	NA	NA	15.5%	91.7%	26.9%	12/88
27.7%	8.1%	111.2	14.7	13.4%	10.6%	33.0%	13.2%	31.9%	4/88
43.9%	5.3%	85.1	10.0	23.3%	21.9%	68.5%	2.0%	71.1%	6/88
39.9%	7.7%	100.4	11.5	13.4%	32.6%	44.9%	14.6%	60.6%	6/88
65.2%	5.9%	147.6	8.6	9.3%	140.3%	25.1%	1.4%	14.0%	6/88
72.8%	5.0%	61.5	1.6	3.3%	-10.9%	80.7%	16.0%	39.3%	12/88
75.0%	0.0%	280.3	11.8	9.6%	25.3%	55.1%	44.2%	0.0%	5/88
68.3%	5.3%	109.0	6.7	73.3%	90.1%	59.5%	41.5%	24.1%	3/88
11.4%	17.9%	187.4	23.6	54.6%	33.8%	57.4%	31.0%	34.0%	12/88
50.8%	13.4%	98.4	-0.7	13.0%	NM	75.9%	21.0%	45.7%	12/88
70.1%	3.8%	229.3	8.4	100.6%	56.5%	67.9%	38.1%	20.9%	6/88
61.6%	4.7%	254.0	22.1	NA	NA	6.0%	52.9%	70.5%	12/88
37.4%	13.8%	82.1	7.1	15.5%	15.6%	63.4%	8.4%	33.2%	10/88
46.6%	2.6%	94.1	5.5	NA	NA	63.5%	70.3%	62.3%	9/88
66.0%	0.0%	95.7	7.1	14.1%	13.5%	104.7%	25.2%	15.9%	12/88
59.6%	2.3%	79.0	3.3	79.6%	78.6%	31.9%	82.9%	14.6%	2/88
64.4%	0.8%	137.2	4.5	11.8%	32.4%	61.5%	28.5%	48.7%	12/88
59.7%	5.9%	65.8	2.8	1.3%	-3.6%	58.8%	32.8%	19.6%	9/88
64.6%	2.7%	77.2	5.2	20.5%	26.0%	61.0%	38.1%	43.0%	12/88
49.8%	12.0%	205.5	22.7	28.0%	51.0%	38.5%	9.8%	55.8%	10/88
82.5%	0.0%	172.4	3.8	20.9%	-8.3%	168.5%	67.1%	0.0%	12/88

(Continued)

THE ELECTRONIC BUSINESS 200

FINANCIAL TABLES: 101-150

Rank 1988	Rank 1987	Company	Calendar year 1988 Electronics revenue ($ millions)	Calendar year 1988 Total revenue ($ millions)	Calendar year 1988 Net income ($ millions)	Fiscal year 1988 Total revenue ($ millions)	Fiscal year 1988 Net income ($ millions)	Return on equity	Return on investment
101	112	Penn Central	$400	$1,546.5	$94.1	$1,546.5	$94.1	5.3%	4.9%
102	104	Dynatech	399	398.7	25.0	367.8	24.5	16.1%	12.1%
103	176	Oracle Systems	395	394.9	56.3	282.1	42.9	31.9%	29.3%
104	93	LTV	388	7,324.7	-890.6	7,324.7	-890.6	-17.2%	-17.1%
105	137	LSI Logic	379	378.9	23.8	378.9	23.8	7.2%	4.3%
106	103	Diebold	369	450.6	31.3	450.6	31.3	8.7%	8.5%
107	—	Micron Technology	368	367.7	121.7	300.5	98.0	34.0%	31.4%
108	121	Westmark International	365	365.3	10.4	365.3	10.4	4.5%	4.3%
109	110	Dataproducts	364	364.1	-11.4	345.2	-20.2	-10.8%	-8.5%
110	80	Corning Glass Works	363	2,121.5	292.4	2,121.5	210.7	13.5%	10.1%
111	118	Eli Lilly	360	4,069.7	761.0	4,069.7	761.0	23.6%	20.3%
112	120	Premier Industrial	354	571.0	68.3	535.9	64.0	22.2%	21.7%
113	124	Micropolis	353	353.1	-19.4	353.1	-19.4	-16.0%	-9.2%
114	111	Polaroid	350	1,862.9	-22.6	1,862.9	-22.6	-2.2%	-1.5%
115	—	Reliance Electric	344	1,303.0	27.0	1,303.0	27.0	58.7%	2.9%
116	115	DSC Communications	340	339.7	20.0	339.7	20.0	9.3%	6.1%
117	145	Maxtor	339	339.0	9.9	271.2	14.1	11.9%	6.0%
118	113	Datapoint	335	334.5	6.2	330.8	8.0	4.4%	2.7%
119	—	Everex Systems	330	329.9	14.2	266.7	10.5	11.4%	10.5%
120	114	Augat	321	321.0	-22.8	321.0	-22.8	-12.5%	-10.8%
121	135	Wyle Laboratories	318	410.9	7.8	410.9	7.8	8.3%	5.5%
122	139	Kollmorgen	317	344.8	14.1	344.8	14.1	15.8%	8.7%
123	147	Applied Magnetics	316	315.7	23.9	293.0	23.7	14.1%	11.1%
124	92	Textron	313	7,285.5	272.1	7,285.5	272.1	11.4%	3.3%
125	117	Cubic	311	363.8	14.2	364.9	12.2	10.4%	6.4%
126	190	3Com	310	309.9	29.3	251.9	22.5	14.4%	14.0%
127	123	Tandon	309	309.3	-19.9	309.3	-19.9	-21.2%	-17.7%
128	131	Foxboro	308	539.9	9.8	539.9	9.8	5.0%	3.4%
129	132	Ashton-Tate	307	307.3	47.8	307.3	47.8	20.5%	20.0%
130	—	Novell	307	306.7	34.6	281.2	30.4	22.4%	16.2%
131	125	Bolt Beranek and Newman	302	302.1	6.1	305.2	18.1	16.3%	9.0%
132	154	Mentor Graphics	301	300.8	33.5	300.8	33.5	15.1%	14.9%
133	—	Audiovox	300	320.2	0.3	320.2	0.3	0.4%	0.2%
134	146	Pioneer-Standard	299	299.0	7.7	254.6	5.2	15.4%	5.8%
135	136	Watkins-Johnson	292	292.2	20.6	292.2	20.6	15.4%	13.0%
136	119	Genicom	291	291.4	1.0	291.4	1.0	1.6%	0.6%
137	133	Savin	288	360.6	-15.1	360.6	-15.1	-26.6%	-12.3%
138	141	Gerber Scientific	288	288.4	31.7	264.0	29.6	17.5%	15.6%
139	127	Square D	282	1,656.8	118.9	1,656.8	118.9	18.7%	10.5%
140	130	Diasonics	282	281.6	9.8	281.6	9.8	8.4%	6.6%
141	—	Sequa	281	1,712.6	71.6	1,712.6	71.5	10.2%	5.2%
142	138	CTS	276	275.6	-2.2	275.6	-3.3	-2.8%	-2.3%
143	143	Bell Industries	273	430.6	12.2	431.6	12.8	11.0%	9.3%
144	142	Cooper Industries	270	4,258.3	224.4	4,258.3	224.4	12.7%	7.4%
145	175	Combustion Engineering	270	3,483.9	-245.2	3,483.9	-245.2	-41.3%	-23.8%
146	178	Stratus Computer	265	265.3	29.3	265.3	29.3	21.1%	19.3%
147	152	Measurex	265	265.2	37.1	265.2	37.1	18.1%	17.6%
148	166	Anthem Electronics	265	264.6	11.3	264.6	11.3	14.0%	12.3%
149	134	Figgie International	264	1,200.2	61.9	1,203.9	61.9	16.9%	8.8%
150	150	Andrew	264	263.9	13.7	253.5	13.9	8.4%	7.2%

NA = not available
NM = not meaningful

Fiscal year 1988				Five-year growth (Compounded average annual growth rate)					
Cost of goods as a percentage of revenue	R&D as a percentage of revenue	Revenue per employee ($ thousands)	Net income per employee ($ thousands)	Revenue	Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
58.1%	0.6%	$111.3	$6.8	-9.4%	36.7%	28.1%	8.7%	20.2%	12/88
42.6%	9.4%	120.2	8.0	22.3%	20.2%	39.5%	25.0%	28.3%	3/88
57.6%	9.1%	127.8	19.4	123.7%	130.6%	55.4%	8.1%	47.5%	5/88
82.7%	0.0%	188.8	-23.0	9.9%	NM	-63.7%	0.4%	0.0%	12/88
47.8%	9.8%	117.3	7.4	61.2%	19.1%	128.5%	40.6%	38.4%	12/88
66.8%	3.1%	98.8	6.9	0.2%	-8.6%	33.2%	1.6%	8.9%	12/88
33.4%	3.1%	134.8	43.9	87.0%	NM	35.9%	7.6%	31.4%	8/88
52.4%	10.3%	113.2	3.2	12.3%	NM	54.1%	4.0%	28.5%	12/88
69.6%	7.7%	97.3	-5.7	1.7%	NM	-72.1%	22.0%	29.4%	3/88
58.6%	4.5%	80.7	8.0	5.3%	18.0%	87.0%	24.9%	17.4%	12/88
27.8%	13.3%	158.4	29.6	8.3%	10.7%	57.4%	13.8%	37.0%	12/88
50.6%	0.5%	124.6	14.9	11.0%	15.6%	13.3%	2.3%	0.0%	5/88
87.8%	8.0%	110.4	-6.1	46.9%	NM	-1,354.1%	42.6%	69.0%	12/88
49.4%	8.0%	160.4	-1.9	8.2%	NM	661.5%	35.0%	43.7%	12/88
69.8%	0.0%	100.2	2.1	NA	NA	25.8%	95.1%	10.4%	12/88
50.0%	13.2%	122.8	7.2	11.5%	-9.9%	103.0%	34.0%	19.5%	12/88
68.2%	8.8%	86.4	4.5	NA	NA	153.0%	49.3%	16.0%	3/88
48.1%	3.5%	122.8	3.0	-9.3%	-0.2%	82.2%	38.4%	84.5%	7/88
74.7%	5.9%	166.7	6.6	NA	NA	33.0%	7.6%	11.9%	7/88
70.6%	4.1%	89.2	-6.3	6.9%	NM	-147.8%	13.6%	20.4%	12/88
75.9%	0.0%	188.9	3.6	16.0%	NM	93.0%	34.0%	0.0%	1/89
64.0%	4.2%	88.4	3.6	5.8%	9.6%	65.3%	45.0%	23.9%	12/88
67.3%	7.7%	31.0	2.5	23.6%	28.7%	137.8%	21.1%	44.7%	9/88
55.9%	2.3%	121.4	4.5	30.8%	25.1%	55.9%	71.1%	25.6%	12/88
74.6%	1.6%	96.0	3.2	6.0%	-6.7%	50.3%	38.7%	4.6%	9/88
43.2%	9.3%	186.9	16.7	121.3%	331.9%	61.7%	2.3%	27.0%	5/88
77.3%	4.4%	208.5	-13.4	0.4%	NM	-51.7%	16.8%	10.0%	12/88
58.6%	6.9%	101.9	1.9	0.3%	4.2%	67.3%	31.7%	50.9%	12/88
8.3%	17.2%	245.8	38.2	48.2%	55.4%	52.0%	2.4%	39.5%	1/89
40.6%	5.7%	177.5	19.2	118.3%	NM	40.4%	28.0%	32.4%	10/88
55.9%	4.8%	97.2	5.8	29.0%	40.7%	84.9%	44.5%	0.0%	6/88
39.7%	11.2%	176.0	19.6	63.4%	NM	62.6%	1.8%	47.8%	12/88
79.5%	0.0%	291.0	0.3	NA	NA	60.9%	44.5%	0.0%	11/88
75.2%	0.0%	292.6	6.0	16.5%	53.7%	27.5%	62.5%	0.0%	3/88
58.9%	6.3%	92.8	6.5	9.5%	3.0%	39.4%	15.4%	26.0%	12/88
67.7%	3.6%	78.9	0.3	NA	NA	87.3%	63.7%	27.6%	12/88
61.4%	1.0%	178.4	-7.5	-2.2%	-1.5%	23.4%	53.8%	11.9%	12/88
45.5%	6.5%	142.7	16.0	17.7%	45.8%	44.9%	10.6%	53.0%	4/88
62.9%	3.0%	80.8	5.8	8.7%	12.3%	66.0%	43.9%	19.8%	12/88
60.1%	7.2%	169.6	5.9	17.6%	NM	52.8%	22.0%	39.5%	12/88
70.8%	1.0%	107.0	4.5	42.6%	NM	72.8%	49.0%	30.1%	12/88
70.7%	1.6%	43.2	-0.5	5.1%	NM	49.2%	18.0%	19.4%	12/88
74.9%	0.0%	227.2	6.7	14.0%	13.4%	38.8%	15.5%	0.0%	6/88
64.6%	0.0%	92.0	4.8	18.1%	-33.4%	44.5%	41.9%	22.5%	12/88
91.1%	1.6%	120.8	-8.5	8.9%	NM	-51.6%	42.4%	39.5%	12/88
35.0%	11.5%	155.1	17.2	66.8%	68.0%	43.4%	8.5%	28.2%	12/88
49.8%	7.2%	101.2	14.1	16.7%	50.5%	23.5%	2.9%	84.5%	11/88
76.7%	0.0%	529.3	22.6	43.7%	52.7%	5.7%	12.1%	0.0%	12/88
71.0%	1.3%	69.2	3.6	13.4%	21.8%	75.7%	48.1%	0.0%	12/88
59.4%	5.6%	94.6	5.2	7.8%	-4.7%	46.1%	14.5%	53.3%	9/88

(Continued)

THE ELECTRONIC BUSINESS 200

FINANCIAL TABLES: 151-200

Rank 1988	Rank 1987	Company	Calendar year 1988 Electronics revenue ($ millions)	Calendar year 1988 Total revenue ($ millions)	Calendar year 1988 Net income ($ millions)	Fiscal year 1988 Total revenue ($ millions)	Fiscal year 1988 Net income ($ millions)	Return on equity	Return on investment
151	129	Recognition Equipment	$262	$261.5	-$13.1	$260.8	-$12.2	-11.0%	-6.2%
152	140	Bally Manufacturing	260	1,940.8	38.0	1,940.8	38.0	6.5%	1.7%
153	—	Dell Computer	258	257.8	14.4	257.8	14.4	19.2%	13.2%
154	—	Conner Peripherals	257	256.6	19.8	256.6	19.8	18.8%	15.3%
155	128	TIE/communications	255	255.3	-17.0	255.3	-17.0	-14.6%	-11.7%
156	148	Reynolds and Reynolds	250	605.4	21.9	600.1	18.1	9.0%	6.0%
157	—	Management Science America	250	250.0	-33.6	250.0	-33.6	-108.4%	-88.7%
158	144	Ball	245	1,073.0	32.7	1,073.0	32.7	7.8%	5.0%
159	—	Vishay Intertechnology	244	244.4	17.1	109.0	15.5	16.4%	6.9%
160	153	BRIntec	240	337.3	5.7	337.3	5.7	8.7%	3.8%
161	—	Concurrent Computer	240	239.9	-8.1	263.1	14.4	7.4%	6.5%
162	151	Sundstrand	239	1,477.3	-50.1	1,477.3	-50.1	-8.5%	-5.2%
163	185	Inmac	236	236.0	7.6	222.8	9.7	21.5%	17.0%
164	165	Cincinnati Milacron	233	857.8	25.0	857.8	25.0	11.0%	5.8%
165	167	Imo Industries	232	687.2	28.3	687.2	28.3	9.6%	4.8%
166	161	Fluke	232	231.6	13.0	224.5	12.4	9.4%	8.9%
167	158	Logicon	231	231.0	8.9	218.9	9.1	15.0%	15.0%
168	174	Olin	231	2,308.0	98.0	2,308.0	98.0	14.3%	7.4%
169	196	Tyco Laboratories	230	1,792.5	82.0	1,574.6	66.5	22.7%	10.4%
170	164	DCA	226	226.4	26.5	227.5	42.2	20.8%	20.8%
171	188	VLSI Technology	221	221.2	6.7	221.2	6.7	4.5%	2.6%
172	171	Esterline	216	288.5	7.9	284.4	8.4	10.3%	7.9%
173	172	Dynascan	214	213.8	7.2	213.8	7.2	14.6%	8.4%
174	156	Cullinet Software	208	207.8	-42.4	216.7	-47.0	-62.3%	-50.4%
175	187	Cipher Data Products	206	206.5	14.6	185.4	10.4	7.0%	6.9%
176	169	GenRad	206	205.9	-6.2	205.9	-6.2	-9.3%	-4.7%
177	184	Thomas & Betts	206	514.6	58.7	514.6	58.7	18.6%	14.5%
178	106	AM International	205	820.7	8.1	820.7	8.1	3.5%	1.6%
179	—	Fairchild Industries	205	538.7	15.5	550.4	15.5	10.8%	6.2%
180	163	Ultimate	204	203.9	-8.7	209.2	13.0	12.6%	11.8%
181	170	General DataComm	203	203.2	-11.3	192.2	-18.4	-28.8%	-18.5%
182	—	QMS	199	199.2	-4.4	186.7	-5.0	-8.3%	-4.7%
183	186	Oak Industries	198	197.8	12.9	197.8	12.9	14.0%	10.0%
184	—	International Rectifier	195	195.2	-11.2	178.6	-12.1	-41.5%	-6.5%
185	—	Flextronics	194	194.5	-1.5	146.4	5.2	12.6%	8.0%
186	179	Sun Electric	190	190.0	-4.2	190.0	-4.2	-5.6%	-3.5%
187	200	Pittway	190	771.1	37.3	771.1	37.3	11.1%	8.9%
188	189	Coherent	189	188.8	-0.2	188.1	-1.3	-1.6%	-1.3%
189	194	Cherry Electrical	186	210.9	7.4	194.6	7.4	10.4%	6.6%
190	—	LTX	182	182.2	-0.4	174.8	7.0	11.4%	8.5%
191	—	Becton, Dickinson	178	1,749.1	160.4	1,709.4	148.9	15.5%	9.0%
192	—	Chips & Technologies	178	177.9	25.4	141.5	22.1	33.2%	31.3%
193	—	Burr-Brown	177	176.7	11.5	176.7	11.5	15.1%	11.1%
194	182	ADC Telecommunications	175	175.3	15.6	179.9	17.0	18.1%	17.5%
195	198	Brush Wellman	173	345.8	32.5	345.8	32.5	14.0%	11.4%
196	181	Quantum	172	172.5	-2.4	188.5	-3.2	-2.8%	-2.8%
197	—	Rexon	171	171.2	9.9	155.5	9.0	13.1%	11.3%
198	—	Integrated Device Technology	170	170.4	18.0	121.1	11.6	13.4%	10.1%
199	—	Aydin	170	169.7	8.4	169.7	8.4	11.0%	9.2%
200	—	Ask Computer Systems	168	168.3	12.2	142.4	10.8	11.8%	11.4%

NA = not available
NM = not meaningful

Fiscal year 1988				Five-year growth (Compounded average annual growth rate)					
Cost of goods as a percentage of revenue	R&D as a percentage of revenue	Revenue per employee ($ thousands)	Net income per employee ($ thousands)	Revenue	Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
55.8%	3.3%	$96.3	-$4.5	17.4%	NM	87.5%	43.8%	56.3%	10/88
63.2%	0.7%	149.3	2.9	17.9%	NM	131.2%	74.2%	0.0%	12/88
67.7%	2.8%	214.8	12.0	NA	NA	40.0%	31.2%	15.4%	1/89
76.6%	3.4%	88.6	6.8	NA	NA	122.5%	18.6%	21.6%	12/88
64.5%	5.7%	170.2	-11.3	-4.7%	NM	-44.2%	19.9%	[illegible]0%	12/88
58.1%	2.1%	120.6	3.6	18.9%	8.7%	61.6%	32.7%	10[illegible]%	9/88
NA	23.6%	105.5	-14.2	16.3%	NM	-25.9%	18.2%	23.7%	12/88
80.8%	1.2%	151.1	4.6	3.2%	-3.6%	190.5%	35.6%	0.0%	12/88
58.8%	2.9%	NA	NA	20.9%	28.5%	4.3%	57.9%	65.1%	6/88
78.8%	1.3%	86.5	1.5	5.6%	NA	39.4%	56.3%	16.7%	12/88
46.8%	12.2%	76.3	4.2	4.2%	18.3%	72.8%	11.9%	40.4%	6/88
63.1%	7.8%	107.0	-3.6	10.2%	NM	685.0%	35.2%	24.5%	12/88
62.2%	0.0%	327.7	14.3	NA	NA	34.0%	20.9%	51.4%	7/88
72.2%	4.1%	102.5	3.0	71.9%	17.7%	66.5%	47.1%	19.2%	12/88
66.2%	1.4%	89.2	3.7	11.9%	10.1%	56.8%	49.8%	26.6%	12/88
45.8%	10.4%	93.6	5.2	5.4%	5.3%	68.2%	4.8%	33.4%	9/88
81.9%	0.9%	86.6	3.6	16.2%	15.6%	35.9%	0.0%	0.0%	3/88
72.4%	2.5%	140.7	6.0	6.2%	10.3%	85.0%	48.6%	16.9%	12/88
75.1%	0.4%	131.2	5.5	22.4%	25.4%	42.7%	53.9%	7.8%	5/88
29.7%	11.3%	158.7	29.5	59.9%	82.9%	26.5%	0.0%	22.0%	6/88
44.7%	9.6%	135.7	4.1	43.9%	NM	149.4%	42.3%	29.8%	12/88
58.5%	5.7%	94.2	2.8	8.7%	6.6%	38.2%	23.5%	40.7%	10/88
74.8%	0.9%	482.7	16.4	4.3%	-3.8%	15.8%	42.5%	2.0%	12/88
81.7%	24.2%	90.3	-19.6	20.7%	NM	-29.8%	19.2%	32.6%	4/88
65.2%	9.4%	90.2	5.1	26.6%	-1.2%	27.8%	1.6%	39.1%	6/88
38.3%	14.9%	103.0	-3.1	-1.9%	NM	119.1%	49.4%	31.3%	12/88
48.0%	3.4%	109.5	12.5	11.3%	16.1%	95.2%	22.4%	42.2%	12/88
63.6%	2.6%	108.9	1.1	5.8%	NM	108.4%	53.0%	43.2%	7/88
71.6%	2.1%	110.3	3.1	67.0%	11.3%	120.7%	42.6%	0.0%	12/88
52.2%	2.6%	283.4	17.6	39.8%	23.0%	39.3%	6.4%	33.2%	4/88
51.4%	12.1%	80.1	-7.7	17.6%	NM	-193.8%	35.6%	23.9%	9/88
71.7%	3.1%	196.3	-5.2	66.5%	NM	-500.8%	43.3%	35.0%	9/88
75.3%	1.6%	52.4	3.4	-0.5%	NM	38.9%	28.4%	15.4%	12/88
67.6%	4.3%	77.7	-5.3	15.1%	NM	-8,571.5%	84.4%	43.5%	6/88
83.2%	0.0%	52.9	1.9	82.6%	80.3%	83.6%	36.8%	59.4%	3/88
52.0%	2.8%	77.7	-1.7	4.6%	NM	347.8%	38.3%	44.0%	12/88
60.0%	2.3%	98.9	4.8	12.6%	7.2%	87.7%	20.0%	24.2%	12/88
58.7%	10.5%	110.6	-0.8	15.6%	NM	159.0%	18.0%	38.4%	9/88
62.4%	5.7%	68.7	2.6	17.3%	18.5%	92.2%	36.4%	55.9%	2/88
41.8%	18.1%	123.9	4.9	28.3%	22.8%	89.4%	25.5%	49.2%	7/88
47.1%	5.5%	83.0	7.2	10.6%	36.1%	121.6%	41.8%	37.6%	9/88
47.6%	13.2%	459.3	71.7	NA	NA	27.1%	5.7%	56.0%	6/88
39.5%	8.3%	120.1	7.9	21.8%	21.8%	83.1%	26.8%	69.1%	12/88
49.1%	9.7%	107.1	10.1	18.7%	25.4%	51.7%	3.3%	14.5%	10/88
63.4%	1.9%	132.9	12.5	10.5%	13.4%	54.6%	18.5%	24.3%	12/88
71.4%	6.4%	371.1	-6.4	35.2%	NM	28.8%	0.0%	22.0%	3/88
66.0%	4.7%	133.3	7.7	NA	NA	47.8%	13.5%	35.1%	9/88
34.8%	15.5%	91.2	8.7	NA	NA	110.8%	24.9%	20.0%	3/88
68.4%	5.0%	84.8	4.2	2.1%	-9.7%	26.8%	16.7%	19.7%	12/88
42.9%	8.3%	206.7	15.7	29.3%	22.6%	31.2%	3.5%	12.7%	6/88

(Continued)

THE ELECTRONIC BUSINESS 200

INDUSTRY SEGMENTS

Fiscal 1988 figures Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	200 rank
Mainframes								
Amdahl	$217.1	11.9%	18.5%	47.5%	12.3%	15.5%	43.2%	40
IBM	154.2	9.2%	10.4%	35.0%	9.9%	9.0%	57.6%	1
Cray Research	144.4	20.7%	19.7%	22.2%	15.6%	10.8%	34.5%	71
Control Data	108.3	0.1%	0.1%	64.2%	9.3%	4.7%	29.8%	19
Unisys	106.5	6.9%	8.0%	49.4%	7.2%	6.8%	45.8%	7
NCR	99.8	7.3%	16.1%	48.5%	7.0%	7.0%	58.3%	12
Weighted average	**$139.2**	**8.5%**	**10.3%**	**39.2%**	**9.5%**	**8.6%**	**54.4%**	
Minicomputers								
Stratus Computer	$155.1	11.1%	19.3%	35.0%	11.5%	6.7%	28.2%	146
IBM	154.2	9.2%	10.4%	35.0%	9.9%	9.0%	57.6%	1
Tandem Computers	152.4	7.2%	9.5%	30.6%	12.9%	14.1%	51.0%	46
Sun Microsystems	148.3	6.3%	12.6%	47.5%	13.3%	11.2%	38.4%	44
Apollo Computer	147.0	0.0%	0.1%	51.3%	11.8%	9.2%	56.6%	75
Prime Computer	128.7	0.8%	1.8%	40.7%	10.9%	8.8%	56.6%	43
Hewlett-Packard	[illegible]0	8.3%	16.0%	44.3%	10.4%	6.6%	51.6%	6
MAI Basic Four	[illegible]	5.8%	8.2%	46.6%	2.6%	3.9%	62.3%	93
Digital Equipment	91.4	11.4%	16.8%	43.1%	11.4%	13.2%	49.9%	3
Data General	88.5	-1.1%	-2.2%	43.1%	12.1%	7.1%	46.0%	48
Concurrent Computer	76.3	5.5%	6.5%	46.8%	12.2%	7.8%	40.4%	161
Weighted average	**$133.8**	**8.9%**	**11.2%**	**37.6%**	**10.3%**	**9.3%**	**55.3%**	
Microcomputers								
Apple Computer	$377.0	9.8%	35.4%	47.0%	6.7%	3.5%	32.1%	17
Compaq Computer	299.4	12.4%	23.4%	57.3%	3.6%	13.2%	38.6%	37
Atari	254.0	8.7%	22.3%	61.6%	4.7%	0.5%	70.5%	91
AST Research	229.3	3.7%	8.1%	70.1%	3.8%	3.5%	20.9%	90
Dell Computer	214.8	5.6%	13.2%	67.7%	2.8%	2.6%	15.4%	153
Tandon	208.5	-6.4%	-17.7%	77.3%	4.4%	2.6%	10.0%	127
Everex Systems	166.7	3.9%	10.5%	74.7%	5.9%	1.6%	11.9%	119
IBM	154.2	9.2%	10.4%	35.0%	9.9%	9.0%	57.6%	1
Tandy	102.5	8.3%	15.3%	47.5%	0.0%	2.5%	1.8%	18
Zenith Electronics	74.6	0.2%	0.6%	82.3%	3.7%	1.2%	17.9%	28
Weighted average	**$152.4**	**8.8%**	**11.1%**	**39.4%**	**8.7%**	**8.1%**	**50.7%**	
Computer-based systems								
Ask Computer Systems	$206.7	7.6%	11.4%	42.9%	8.3%	3.8%	12.7%	200
Mentor Graphics	176.0	11.2%	14.9%	39.7%	11.2%	9.7%	47.8%	132
Gerber Scientific	142.7	11.2%	15.6%	45.5%	6.5%	5.8%	53.0%	138
Hewlett-Packard	113.0	8.3%	16.0%	44.3%	10.4%	6.6%	51.6%	6
Coherent	110.8	-0.7%	-1.3%	58.7%	10.5%	4.8%	38.4%	188
Intergraph	109.6	11.0%	13.1%	43.4%	11.1%	8.3%	28.7%	68
Measurex	101.2	14.0%	17.6%	49.8%	7.2%	3.9%	84.5%	147
Recognition Equipment	96.3	-4.7%	-6.2%	55.8%	3.3%	3.5%	56.3%	151
Sun Electric	77.7	-2.2%	-3.5%	52.0%	2.8%	2.6%	44.0%	186
Weighted average	**$113.3**	**8.1%**	**14.4%**	**44.9%**	**10.0%**	**6.5%**	**50.0%**	

For purposes of comparison, only companies whose electronics revenue constitutes over 70% of total revenue are included

THE ELECTRONIC BUSINESS 200

INDUSTRY SEGMENTS

Fiscal 1988 figures Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	200 rank
Semiconductors								
Chips & Technologies	$459.3	15.6%	31.3%	47.6%	13.2%	4.6%	56.0%	192
Intel	138.2	15.8%	16.3%	45.0%	11.1%	16.6%	42.9%	25
VLSI Technology	135.7	3.0%	2.6%	44.7%	9.6%	24.9%	29.8%	171
Micron Technology	134.8	32.6%	31.4%	33.4%	3.1%	14.7%	31.4%	107
Burr-Brown	120.1	6.5%	11.1%	39.5%	8.3%	12.1%	69.1%	193
LSI Logic	117.3	6.3%	4.3%	47.8%	9.8%	26.6%	38.4%	105
Western Digital	116.7	5.6%	11.4%	66.7%	8.8%	4.7%	67.3%	62
Integrated Device Technology	91.2	9.6%	10.1%	34.8%	15.5%	23.0%	20.0%	198
Texas Instruments	83.2	5.8%	12.7%	70.3%	7.8%	10.0%	32.3%	11
Analog Devices	82.1	8.6%	10.2%	37.4%	13.8%	10.8%	33.2%	92
Motorola	80.9	5.4%	9.4%	54.5%	8.1%	10.6%	48.1%	9
International Rectifier	77.7	-6.8%	-6.5%	67.6%	4.3%	7.2%	43.5%	184
National Semiconductor	65.5	2.5%	5.9%	63.3%	11.3%	8.1%	45.2%	30
Advanced Micro Devices	59.5	1.7%	2.7%	45.2%	18.5%	8.7%	18.1%	54
Weighted average	**$84.9**	**6.7%**	**10.9%**	**57.5%**	**9.4%**	**11.1%**	**41.4%**	
Capital equipment								
Applied Materials	$205.5	11.0%	18.0%	49.8%	12.0%	5.5%	55.8%	99
Gerber Scientific	142.7	11.2%	15.6%	45.5%	6.5%	5.8%	53.0%	138
LTX	123.9	4.0%	8.5%	41.8%	18.1%	10.3%	49.2%	190
Hewlett-Packard	113.0	8.3%	16.0%	44.3%	10.4%	6.6%	51.6%	6
Perkin-Elmer	106.2	5.1%	6.3%	51.9%	8.5%	7.2%	48.7%	57
GenRad	103.0	-3.0%	-4.7%	38.3%	14.9%	6.0%	31.3%	176
Varian Associates	99.2	2.4%	5.5%	65.7%	6.9%	3.7%	40.2%	52
Teradyne	98.4	-0.7%	-0.9%	50.8%	13.4%	4.3%	45.7%	89
Esterline	94.2	2.9%	7.9%	58.5%	5.7%	2.3%	40.7%	172
Fluke	93.6	5.5%	8.9%	45.8%	10.4%	7.0%	33.4%	166
Tektronix	87.8	-1.2%	-2.3%	42.8%	15.3%	5.5%	44.4%	45
Sun Electric	77.7	-2.2%	-3.5%	52.0%	2.8%	2.6%	44.0%	186
Weighted average	**$108.3**	**6.2%**	**11.2%**	**46.9%**	**10.4%**	**6.1%**	**49.0%**	
Peripherals								
Quantum	$371.1	-1.7%	-2.8%	71.4%	6.4%	1.6%	22.0%	196
AST Research	229.3	3.7%	8.1%	70.1%	3.8%	3.5%	20.9%	90
QMS	196.3	-2.7%	-4.7%	71.7%	3.1%	2.0%	35.0%	182
Everex Systems	166.7	3.9%	10.5%	74.7%	5.9%	1.6%	11.9%	119
Rexon	133.3	5.8%	11.3%	66.0%	4.7%	3.5%	35.1%	197
Micropolis	110.4	-5.5%	-9.2%	87.8%	8.0%	18.1%	69.0%	113
Wyse Technology	109.0	6.1%	9.9%	68.3%	5.3%	4.6%	24.1%	87
Storage Technology	102.8	5.1%	7.4%	59.2%	7.7%	5.4%	32.5%	66
Dataproducts	97.3	-5.9%	-8.5%	69.6%	7.7%	2.1%	29.4%	109
Cipher Data Products	90.2	5.6%	6.9%	65.2%	9.4%	2.5%	39.1%	175
Conner Peripherals	88.6	7.7%	15.3%	76.6%	3.4%	11.8%	21.6%	154
Maxtor	86.4	5.2%	6.0%	68.2%	8.8%	14.1%	16.0%	117
Genicom	78.9	0.3%	0.6%	67.7%	3.6%	4.2%	27.6%	136
Seagate Technology	41.9	6.2%	10.4%	78.0%	4.0%	22.6%	40.5%	47
Applied Magnetics	31.0	8.1%	11.1%	67.3%	7.7%	18.9%	44.7%	123
Weighted average	**$75.6**	**3.5%**	**5.8%**	**71.0%**	**5.8%**	**10.3%**	**33.0%**	

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THE ELECTRONIC BUSINESS 200

INDUSTRY SEGMENTS

Fiscal 1988 figures Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	200 rank
Software								
Ultimate	$283.4	6.2%	11.8%	52.2%	2.6%	4.2%	33.2%	180
Ashton-Tate	245.8	15.5%	20.0%	8.3%	17.2%	11.8%	39.5%	129
Microsoft	211.5	21.0%	31.3%	22.3%	11.8%	12.1%	47.8%	73
Lotus Development	187.4	12.6%	17.5%	11.4%	17.9%	11.8%	34.0%	88
Computer Associates	158.7	14.4%	16.4%	48.4%	11.5%	2.7%	39.4%	63
Oracle Systems	127.8	15.2%	29.3%	57.6%	9.1%	11.0%	47.5%	103
Management Science America	105.5	-13.4%	-88.7%	-4.8%	23.6%	2.2%	23.7%	157
Cullinet Software	90.3	-21.7%	-50.4%	81.7%	24.2%	3.2%	32.6%	174
Weighted average	**$162.0**	**10.1%**	**15.5%**	**32.7%**	**14.2%**	**7.7%**	**38.7%**	
Communications								
Dynascan	$482.7	3.4%	8.4%	74.8%	0.9%	0.7%	2.0%	173
Inmac	327.7	4.4%	17.0%	62.2%	0.0%	1.7%	51.4%	163
3Com	186.9	8.9%	14.0%	43.2%	9.3%	7.5%	27.0%	126
Novell	177.5	10.8%	16.2%	40.6%	5.7%	5.5%	32.4%	130
TIE/communications	170.2	-6.6%	-11.7%	64.5%	5.7%	1.9%	30.0%	155
DCA	158.7	18.6%	20.8%	29.7%	11.3%	6.0%	22.0%	170
Scientific-Atlanta	147.6	5.8%	12.3%	65.2%	5.9%	2.0%	14.0%	84
Datapoint	122.8	2.4%	2.7%	48.1%	3.5%	5.9%	84.5%	118
DSC Communications	122.8	5.9%	6.1%	50.0%	13.2%	13.5%	19.5%	116
Dynatech	120.2	6.7%	12.1%	42.6%	9.4%	4.1%	28.3%	102
ADC Telecommunications	107.1	9.4%	17.5%	49.1%	9.7%	7.5%	14.5%	194
Bolt Beranek and Newman	97.2	5.9%	9.0%	55.9%	4.8%	9.4%	0.0%	131
Andrew	94.6	5.5%	7.2%	59.4%	5.6%	5.1%	53.3%	150
Motorola	80.9	5.4%	9.4%	54.5%	8.1%	10.6%	48.1%	9
General DataComm	80.1	-9.6%	-18.5%	51.4%	12.1%	4.5%	23.9%	181
General Instrument	75.0	5.7%	9.1%	67.9%	3.2%	5.2%	10.8%	51
Weighted average	**$91.2**	**5.4%**	**9.0%**	**55.2%**	**7.3%**	**8.6%**	**39.2%**	
Consumer								
Emerson Radio	$1,041.2	-1.6%	-5.1%	93.3%	0.0%	0.9%	0.0%	72
Audiovox	291.0	0.1%	0.2%	79.5%	0.0%	0.3%	0.0%	133
Tandy	102.5	8.3%	15.3%	47.5%	0.0%	2.5%	1.8%	18
Zenith Electronics	74.6	0.2%	0.6%	82.3%	3.7%	1.2%	17.9%	28
Weighted average	**$100.6**	**4.1%**	**9.3%**	**65.7%**	**1.3%**	**1.8%**	**7.3%**	
Office equipment								
Savin	$178.4	-4.2%	-12.3%	61.4%	1.0%	0.3%	11.9%	137
IBM	154.2	9.2%	10.4%	35.0%	9.9%	9.0%	57.6%	1
Xerox	114.6	0.6%	0.5%	43.5%	6.9%	4.4%	49.5%	5
NCR	99.8	7.3%	16.1%	48.5%	7.0%	7.0%	58.3%	12
Wang Laboratories	99.3	3.0%	4.1%	40.3%	8.0%	8.9%	46.2%	22
Diebold	98.8	7.0%	8.5%	66.8%	3.1%	1.8%	8.9%	106
Harris	92.9	3.1%	5.8%	60.5%	5.6%	3.9%	15.0%	36
Pitney Bowes	90.4	8.9%	6.5%	27.3%	3.0%	11.7%	21.0%	38
Weighted average	**$134.7**	**7.5%**	**8.4%**	**37.9%**	**8.9%**	**8.2%**	**53.5%**	

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The Electronic Business 200

Industry segments

Fiscal 1988 figures Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	200 rank
Government								
GM Hughes Electronics	$115.9	5.6%	7.4%	70.7%	4.9%	4.7%	12.3%	4
Loral	105.2	5.2%	7.3%	56.9%	4.5%	3.5%	11.2%	55
Varian Associates	99.2	2.4%	5.5%	65.7%	6.9%	3.7%	40.2%	52
Cubic	96.0	3.4%	6.4%	74.6%	1.6%	2.7%	4.6%	125
Harris	92.9	3.1%	5.8%	60.5%	5.6%	3.9%	15.0%	36
Watkins-Johnson	92.8	7.0%	13.0%	58.9%	6.3%	4.0%	26.0%	135
Honeywell	91.2	-6.1%	-15.3%	71.9%	4.5%	4.6%	22.9%	10
Litton Industries	88.4	3.4%	6.1%	74.2%	4.7%	4.7%	26.9%	21
SCI Systems	86.7	2.4%	5.2%	-2.6%	0.0%	5.5%	27.4%	64
Logicon	86.6	4.1%	15.0%	81.9%	0.9%	1.7%	0.0%	167
E-Systems	86.3	5.2%	12.5%	63.1%	NA	3.7%	10.4%	50
Aydin	84.8	4.9%	9.2%	68.4%	5.0%	2.1%	19.7%	199
Texas Instruments	83.2	5.8%	12.7%	70.3%	7.8%	10.0%	32.3%	11
Motorola	80.9	5.4%	9.4%	54.5%	8.1%	10.6%	48.1%	9
M/A-COM	65.8	4.3%	5.7%	59.7%	5.9%	5.5%	19.6%	97
Weighted average	**$92.4**	**3.3%**	**5.7%**	**65.7%**	**6.2%**	**6.3%**	**25.7%**	
Medical								
Diasonics	$169.6	3.5%	6.6%	60.1%	7.2%	3.7%	39.5%	140
Westmark International	113.2	2.9%	4.3%	52.4%	10.3%	3.1%	28.5%	108
Medtronic	111.2	13.2%	19.0%	27.7%	8.1%	5.1%	31.9%	81
Weighted average	**$120.8**	**8.2%**	**12.6%**	**41.7%**	**8.6%**	**4.3%**	**32.6%**	
Components								
AMP	$112.0	11.8%	18.3%	56.1%	8.8%	8.2%	53.6%	33
LPL Investment Group	89.9	1.6%	1.7%	60.1%	1.6%	1.2%	26.9%	80
Augat	89.2	-7.1%	-10.8%	70.6%	4.1%	5.5%	20.4%	120
BRIntec	86.5	1.7%	3.8%	78.8%	1.3%	1.5%	16.7%	160
Molex	85.1	11.8%	14.9%	43.9%	5.3%	13.7%	71.1%	82
AVX	77.2	6.7%	8.2%	64.6%	2.7%	8.0%	43.0%	98
Cherry Electrical	68.7	3.8%	6.6%	62.4%	5.7%	9.1%	55.9%	189
Sprague Technologies	61.5	2.6%	3.4%	72.8%	5.0%	7.6%	39.3%	85
Oak Industries	52.4	6.5%	10.0%	75.3%	1.6%	3.8%	15.4%	183
CTS	43.2	-1.2%	-2.3%	70.7%	1.6%	3.6%	19.4%	142
Vishay Intertechnology	NA	14.2%	6.9%	58.8%	2.9%	0.8%	65.1%	159
Weighted average	**$87.0**	**7.2%**	**10.2%**	**61.0%**	**5.7%**	**6.9%**	**44.4%**	
Distribution								
Anthem Electronics	$529.3	4.3%	12.3%	76.7%	0.0%	0.3%	0.0%	148
Arrow Electronics	362.7	1.0%	3.4%	77.7%	0.0%	0.5%	0.0%	59
Pioneer-Standard	292.6	2.0%	5.8%	75.2%	0.0%	0.8%	0.0%	134
Marshall Industries	280.3	4.2%	16.2%	75.0%	0.0%	2.6%	0.0%	86
Wyle Laboratories	188.9	1.9%	5.5%	75.9%	0.0%	2.3%	0.0%	121
Avnet	182.9	2.9%	5.7%	73.8%	0.0%	1.4%	0.0%	42
Weighted average	**$234.9**	**2.5%**	**6.3%**	**75.3%**	**0.0%**	**1.3%**	**0.0%**	

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THE ELECTRONIC BUSINESS 200

BEST AND WORST PERFORMERS

Net income/sales

(percentage)		200 rank
TOP 10		
Micron Technology	32.6%	107
Microsoft	21.0%	73
Cray Research	20.7%	71
Eli Lilly	18.7%	111
Digital Communications	18.6%	170
Intel	15.8%	25
Chips & Technologies	15.6%	192
Ashton-Tate	15.5%	129
Oracle Systems	15.2%	103
Computer Associates	14.4%	63
MEDIAN	**4.9%**	
BOTTOM 5		
Augat	-7.1%	120
General DataComm	-9.6%	181
LTV	-12.2%	104
MSA	-13.4%	157
Cullinet Software	-21.7%	174

Sales per employee

($ thousands)		200 rank
TOP 10		
Emerson Radio	$1,041.2	72
Anthem Electronics	529.3	148
Dynascan	482.7	173
Chips & Technologies	459.3	192
Apple Computer	377.0	17
Quantum	371.1	196
Arrow Electronics	362.7	59
Inmac	327.7	163
Compaq Computer	299.4	37
Pioneer-Standard	292.6	134
MEDIAN	**$109.5**	
BOTTOM 5		
Flextronics	$52.9	185
Oak Industries	52.4	183
CTS	43.2	142
Seagate Technology	41.9	47
Applied Magnetics	31.0	123

Five-year net income growth

(compound average annual)		200 rank
TOP 10		
3Com	331.9%	126
Sun Microsystems	152.0%	44
Compaq Computer	150.3%	37
Scientific-Atlanta	140.3%	84
Oracle Systems	130.6%	103
Western Digital	96.3%	62
Wyse Technology	90.1%	87
Digital Communications	82.9%	170
Microsoft	80.4%	73
Flextronics	80.3%	185
MEDIAN	**9.6%**	
BOTTOM 5		
General Signal	-22.4%	69
Cooper Industries	-33.4%	144
Zenith Electronics	-35.2%	28
Apollo Computer	-55.5%	75
Control Data	-58.1%	19

Return on equity

(percentage)		200 rank
TOP 10		
Reliance Electric	58.7%	115
Atari	47.3%	91
Apple Computer	39.9%	17
Micron Technology	34.0%	107
Chips & Technologies	33.2%	192
Microsoft	33.0%	73
Oracle Systems	31.9%	103
Compaq Computer	31.3%	37
Marshall Industries	29.0%	85
MAI Basic Four	27.6%	93
MEDIAN	**13.2%**	
BOTTOM 5		
General DataComm	-28.8%	181
Combustion Engineering	-41.3%	145
International Rectifier	-41.5%	184
Cullinet Software	-62.3%	174
MSA	-108.4%	157

Net income per employee

($ thousands)		200 rank
TOP 10		
Chips & Technologies	$71.7	192
Microsoft	44.4	73
Micron Technology	43.9	107
Ashton-Tate	38.2	129
Apple Computer	37.1	17
Compaq Computer	37.0	37
Cray Research	29.9	71
Eli Lilly	29.6	111
Digital Communications	29.5	170
Amdahl	25.8	40
MEDIAN	**$5.2**	
BOTTOM 5		
Tandon	-$13.4	127
MSA	-14.2	157
Emerson Radio	-17.1	72
Cullinet Software	-19.6	174
LTV	-23.0	104

Debt/total capital

(percentage)		200 rank
TOP 10		
Reliance Electric	95.1%	115
LPL Investment Group	91.7%	80
International Rectifier	84.4%	184
Mark IV Industries	82.9%	95
Chrysler	78.2%	49
Ford Motor	76.5%	20
Bally Manufacturing	74.2%	152
Textron	71.1%	124
MAI Basic Four	70.3%	93
Westinghouse Electric	69.8%	29
MEDIAN	**28.5%**	
BOTTOM 5		
Intergraph	0.7%	68
LTV	0.4%	104
Quantum	0.0%	196
Digital Communications	0.0%	170
Logicon	0.0%	167

Return on investment

(percentage)		200 rank
TOP 10		
Apple Computer	35.4%	17
Micron Technology	31.4%	107
Microsoft	31.3%	73
Chips & Technologies	31.3%	192
Oracle Systems	29.3%	103
Compaq Computer	23.4%	37
Atari	22.3%	91
Premier Industrial	21.7%	112
Digital Communications	20.8%	170
Eli Lilly	20.3%	111
MEDIAN	**8.2%**	
BOTTOM 5		
Tandon	-17.7%	127
General DataComm	-18.5%	181
Combustion Engineering	-23.8%	145
Cullinet Software	-50.4%	174
MSA	-88.7%	157

Five-year revenue growth

(compound average annual)		200 rank
TOP 10		
Sun Microsystems	161.2%	44
Oracle Systems	123.7%	103
3Com	121.3%	126
Novell	118.3%	130
AST Research	100.6%	90
Micron Technology	87.0%	107
Flextronics	82.6%	185
Mark IV Industries	79.6%	95
Compaq Computer	79.4%	37
Wyse Technology	73.3%	87
MEDIAN	**12.4%**	
BOTTOM 5		
GenRad	-1.9%	176
Savin	-2.2%	137
TIE/communications	-4.7%	155
Datapoint	-9.3%	118
Penn Central	-9.4%	101

Foreign revenue/total revenue

(percentage)		200 rank
TOP 10		
Datapoint	84.5%	118
Measurex	84.5%	147
Molex	71.1%	82
Atari	70.5%	91
Burr-Brown	69.1%	193
Micropolis	69.0%	113
Western Digital	67.3%	62
Vishay Intertechnology	65.1%	159
MAI Basic Four	62.3%	93
Raychem	60.6%	83
MEDIAN	**32.3%**	
BOTTOM 5		
EG&G	7.6%	78
Grumman	4.8%	61
Cubic	4.6%	125
Dynascan	2.0%	173
Tandy	1.8%	18

THE ELECTRONIC BUSINESS 200

ARRIVALS AND DEPARTURES

ARRIVALS	1988 rank
Ask Computer Systems	200
Audiovox	133
Becton, Dickinson	191
Burr-Brown	193
Chips & Technologies	192
Concurrent Computer	161
Dell Computer	153
Fairchild Industries	179
Flextronics	185
Genicom	136
Integrated Device Technology	198
International Rectifier	184
LTX	190
Management Science America	157
Micron Technology	107
Novell	130
QMS	182
Reliance Electric	115
Rexon	197
Sequa	141
Vishay Intertechnology	159

DEPARTURES	1987 rank
Altos Computer Systems	192
Ametek	177
Avantek	155
Bell & Howell[1]	168
Burndy[2]	183
Compugraphic[3]	100
Computervision[4]	75
Convergent[5]	98
Decision Industries[6]	173
Gencorp	195
Gould[7]	60
ISC Systems[8]	180
Insilco[9]	199
[illegible] Iligent Systems	193
Micom Systems[10]	157
NBI	191
Paradyne[11]	149
Singer[12]	40
Tyler	84
United Industrial	197
Veeco Instruments[13]	159
Xidex[14]	85

[1] acquired by the Bass Group May 17, 1988

[2] acquired by Frametome SA Jan. 10, 1989

[3] merged with Agfa-Gevaert Inc., a unit of Bayer AG June 15, 1988

[4] acquired by Prime Computer Inc. (rank 43) Feb. 5, 1988

[5] acquired by Unisys Corp. (rank 7) Dec. 22, 1988

[6] acquired by Onset Corp. April 29, 1988

[7] acquired by Nippon Mining Co. Nov.1, 1988

[8] acquired by Ing. C. Olivetti & Co. SpA May 5, 1989

[9] acquired by INR Acquisition Corp., a unit of Wagner & Brown Sept. 29, 1988

[10] acquired by Odyssey Partners Sept. 15, 1988

[11] acquired by American Telephone & Telegraph Co. Jan. 8, 1989

[12] acquired by Bilzerian Partners L.P.1 April 19, 1988

[13] acquired by VII Merger Corp. a unit of Unitech Plc Feb. 22, 1989

[14] acquired by Anacomp Inc. Aug. 29, 1988

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THE ELECTRONIC BUSINESS 200

ALPHABETICAL INDEX

Company	Rank
ADC Telecommunications Inc.	194
AM International Inc.	178
AMP Inc.	33
AST Research Inc.	90
AT&T	2
AVX Corp.	98
Advanced Micro Devices Inc.	54
Allied-Signal Inc.	27
Amdahl Corp.	40
Analog Devices Inc.	92
Andrew Corp.	150
Anthem Electronics Inc.	148
Apollo Computer Inc.	75
Apple Computer Inc.	17
Applied Magnetics Corp.	123
Applied Materials Inc.	99
Arrow Electronics Inc.	59
Ashton-Tate Corp.	129
Ask Computer Systems Inc.	200
Atari Corp.	91
Audiovox Corp.	133
Augat Inc.	120
Avnet Inc.	42
Aydin Corp.	199
BRIntec Corp.	160
Ball Corp.	158
Bally Manufacturing Corp.	152
Becton, Dickinson & Co.	191
Bell Industries Inc.	143
Boeing Co., The	34
Bolt Beranek and Newman Inc.	131
Brush Wellman Inc.	195
Burr-Brown Corp.	193
CTS Corp.	142
Cherry Electrical Products Corp.	189
Chips & Technologies Inc.	192
Chrysler Corp.	49
Cincinnati Milacron Inc.	164
Cipher Data Products Inc.	175
Coherent Inc.	188
Combustion Engineering Inc.	145
Compaq Computer Corp.	37
Computer Associates International Inc.	63
Concurrent Computer Corp.	161
Conner Peripherals Inc.	154
Contel Corp.	79
Control Data Corp.	19
Cooper Industries Inc.	144
Corning Glass Works	110
Cray Research Inc.	71
Cubic Corp.	125
Cullinet Software Inc.	174
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Data General Corp.	48
Datapoint Corp.	118
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Dell Computer Corp.	153
Diasonics Inc.	140
Diebold Inc.	106
Digital Communications Associates Inc.	170
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Dover Corp.	94
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Eaton Corp.	67
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General Dynamics Corp.	53
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ITT Corp.	31
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Inmac Corp.	163
Integrated Device Technology Inc.	198
Intel Corp.	25
Intergraph Corp.	68
International Rectifier Corp.	184
Johnson Controls Inc.	65
Kollmorgen Corp.	122
LPL Investment Group Inc.	80
LSI Logic Corp.	105
LTV Corp.	104
LTX Corp.	190
Litton Industries Inc.	21
Lockheed Corp.	16
Logicon Inc.	167
Loral Corp.	55
Lotus Development Corp.	88
M/A-COM Inc.	97
MAI Basic Four Inc.	93
Management Science America Inc.	157
Mark IV Industries Inc.	95
Marshall Industries	86
Martin Marietta Corp.	23
Maxtor Corp.	117
McDonnell Douglas Corp.	41
Measurex Corp.	147
Medtronic Inc.	81
Mentor Graphics Corp.	132
Micron Technology Inc.	107
Micropolis Corp.	113
Microsoft Corp.	73
MiniScribe Corp.	77
Minnesota Mining & Manufacturing Co.	24
Molex Inc.	82
Monsanto Co.	76
Motorola Inc.	9
NCR Corp.	12
Nashua Corp.	96
National Semiconductor Corp.	30
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Novell Inc.	130
Oak Industries Inc.	183
Olin Corp.	168
Oracle Systems Corp.	103
Penn Central Corp.	101
Perkin-Elmer Corp., The	57
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Pitney Bowes Inc.	38
Pittway Corp.	187
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Prime Computer Inc.	43
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Reliance Electric	115
Rexon Inc.	197
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SmithKline Beckman Corp.	70
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Square D Co.	139
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Stratus Computer Inc.	146
Sun Electric Corp.	186
Sun Microsystems Inc.	44
Sundstrand Corp.	162
TIE/communications Inc.	155
TRW Inc.	26
Tandem Computers Inc.	46
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Tandy Corp.	18
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Teradyne Inc.	89
Texas Instruments Inc.	11
Textron Inc.	124
Thomas & Betts Corp.	177
3Com Corp.	126
Tyco Laboratories Inc.	169
Ultimate Corp., The	180
Unisys Corp.	7
United Technologies Corp.	58
United Telecommunications Inc.	100
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Vishay Intertechnology Inc.	159
Wang Laboratories Inc.	22
Watkins-Johnson Co.	135
Western Digital Corp.	62
Westinghouse Electric Corp.	29
Westmark International Inc.	108
Wyle Laboratories Inc.	121
Wyse Technology	87
Xerox Corp.	5
Zenith Electronics Corp.	28

The "new" Amphenol: Will it exist tomorrow?

Can the "sleeping giant" outlast a disruptive reorganization and faltering image to remain a connector leader? President Martin Loeffler thinks so

BY BARBARA N. BERKMAN

Amphenol Corp. president Martin Loeffler is casting quizzical looks at the bloated horsefly buzzing around his head. Nestled in a booth at a local lunch spot set in a commercial development near headquarters in suburban Wallingford, Conn., Loeffler displays an alarming ambivalence to the fly now bashing against the window behind his head.

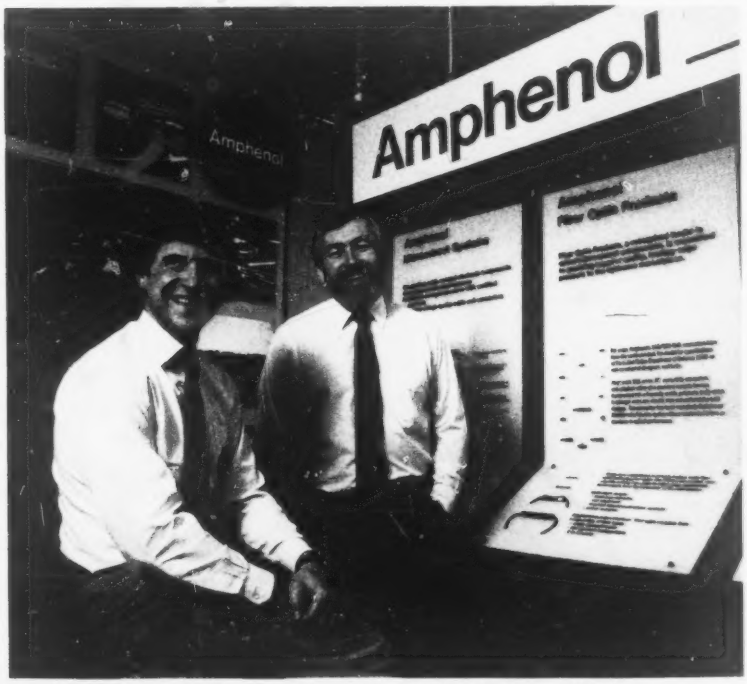
Another man would crush the intruder; Loeffler, a gentle and affable Austria native who has led connector-maker Amphenol the last two years, will wait for it to disappear. There is none of the competitive blood lust expected of an executive running a company in a critical period of transition.

"Amphenol intends to solidify its position as the No. 2 world supplier. It means they have to be very assertive and aggressive to hold that position," notes Kenneth Fleck, president of market researcher Fleck Telesis Inc. in Huntington Beach, Calif.

Dogged by price erosion and a blitz of mergers and acquisitions, connector makers are struggling to hold market share. But as more original equipment manufacturers whittle down their vendor lists, Loeffler's competitors are posed to carve that market share out of Amphenol's hide. Already, Amphenol's $467 million position is threatened by "the third- to seventh-ranked firms [that] all have very high ambitions to be the second world-ranked leader," adds Fleck.

But fierce competition isn't Amphenol's only problem. Since diversified technology company Allied Corp. (now Allied-Signal Inc.) spun off Amphenol in a leveraged buyout in June 1987, the company has struggled to convince customers that it would not be sold piecemeal for assets by the purchaser, an investor group from outside the connector industry. Customers, alienated by Amphenol's shaky image, also have been put off by the company's willingness to raise prices in areas where they are the market leaders.

"Their biggest challenge is to hold market share because their pricing is higher," says Marian Mortfeld, product manager for Amphenol's radio frequency connector line at distributor Aztech Electronics Inc. in Columbia, Md.



Amphenol's Martin Loeffler, president, left, and Allan Dickson, director of marketing: Tending to Amphenol's shaky image

Martin Cooke

Difficult goals

The change in pricing structures is only one of many at Amphenol, which is struggling to become the low-cost producer by improving lead and delivery times, quality and global market share. Exacerbated by extreme pricing pressures on connectors, the goals are difficult ones. For now, Loeffler has been only partially successful in meeting them.

Even that is an improvement for Amphenol, once "the industry sleeping giant," says Stephen Balog, a financial analyst with Shearson Lehman Hutton Inc. "They've gone through the trauma mode, a difficult but extremely important period. Now they've invigorated the growth rate

1988 top worldwide connector makers

by focusing on what they do well."

Loeffler's strategy has been to restructure Amphenol — decentralize its direct salesforce, increase its reliance on manufacturing representatives, and shift responsibility for distributors from central headquarters to Amphenol's core divisions: fiber optics, interconnect systems and industrial technology connectors. He also is emphasizing product development — he expects to generate 10% of 1989 sales from new products alone — and is increasing its global presence through foreign joint ventures and expansion of international manufacturing facilities.

By financial measures, Loeffler's results have been good. With 1988 revenue of $467 million, Amphenol sales improved in 1988 by 7.2% over 1987. While under the industry average, when Amphenol was acquired it was just breaking even. The post-acquisition period is the first in seven years that Amphenol has performed within budget. By year-end 1988, Amphenol was showing a 15% return on sales before interest and taxes, the highest in the company's history, according to Loeffler. (In comparison, about 20% of U.S. suppliers perform at a 15% ROS, estimates Fleck.)

Amphenol, a dominant force in the worldwide military market, claims it commands through its Bendix line a hefty 22% market share. Approximately 34% of Amphenol's revenue is generated by Bendix, whose licenses were acquired by Amphenol in 1982. Its other major lines are radio frequency (RF) connectors, also known as coaxial connectors, and flat-ribbon and cable connectors, marketed under the "Spectra-Strip" name. Amphenol says it has a 15% share of the worldwide market for RF connectors, and 20% of the domestic market for cable.

But Amphenol is not the industry price leader, and some say that will hamper its effort to gain market share. Industry leader AMP Inc. "had a significant price decrease in April, and others have been flat. Nobody else has been raising prices drastically," says Charles Patteson, materials manager with Amphenol distributor Hamilton/Avnet in Dallas.

Amphenol has shown it is willing to raise prices, usually by 4% to 6% yearly. But strapped with $53 million in post-LBO interest payments in 1988, its capital resources still trail far behind those of AMP, the worldwide leader with sales of $2.7 billion last year. Clustered with Amphenol are a number of well-capitalized connector makers: ITT Cannon, Molex Inc. and 3M Co., all with 1988 revenue of $450 million to $550 million.

Amphenol itself has been victim of a larger trend in the connector industry: consolidation prompted by high costs and overhead and inferior manufacturing automation. An unprofitable division of Allied, Amphenol was spun off as one of the more than 50 connector makers that were merged or acquired in 1987 and 1988.

Amphenol has struggled to convince customers that it will not be sold piecemeal

Image problems

In a price-sensitive industry where market share spins on customer loyalty, Amphenol is grappling with an image problem with customers who conjectured the company would be stripped for assets. Loeffler says that 80 companies showed interest in buying Amphenol, then a $500 million division, from Allied; 10 went through the due diligence process.

"There were asset strippers, conglomerates who already had business in the connector industry, and there were electronics concerns who were not yet in the industry but wanted to be there," recalls Loeffler. The highest bidder at $430 million and the assumption of $100 million in debt was the LPL Investment Group Inc., which already owned Times Fiber Communications and Times Microwave Systems. A 4-year-old M&A partnership, LPL is headed by Lawrence J. DeGeorge.

An outsider to the clubbish connector industry, DeGeorge is a decisive septuagenarian with an icy penchant for slashing operating costs. It was DeGeorge who moved headquarters from Lisle, Ill., to Connecticut — slicing the corporate staff from 160-odd employees to about 16 in the process.

DeGeorge's chopping block manner has led some to dub him the Frank Lorenzo of the connector industry. "People thought Amphenol would be gobbled up and spit out by this investment group in parts. Now they're starting to realize it's a drawn-out, long-term process," says Allan Dickson, director of marketing. Some customers and distributors, however, still wait for the prophecy to be fulfilled. Says Hamilton/Avnet's Patteson: "It couldn't have been for a long-term investment. Who the hell in their 70s makes a long-term investment?"

Others agreed. "If something happened in an Amphenol division — a division or two had a bad fall — LPL would dump them, too. It's like there was a chopping block up there," says Tom Peters, corporate commodity manager at Wang Laboratories Inc. "The LPL status of a holding company running a manufacturing company is good financial business but not totally good business."

Amphenol has perpetuated misconception by acting slowly to disseminate information; one customer

criticized the supplier for printing a brochure on the "new" Amphenol only seven months ago. And upper management's road shows to garner customer support is a tedious battle. Many saw leadtimes lengthen, quality falter and distribution become chaotic during the reorganization. Explains Ronald Pols, a senior buyer for Northern Telecom Ltd. in Belleville, Ontario: "We were in a wait-and-see pattern, especially when it came to long-term contracts; should we have a relationship or not? Will Amphenol be around next year?"

The DeGeorge factor

As Shearson analyst Balog notes, "massive internal changes cause some dislocation at the client level." But the severity of Amphenol's image problem isn't lost on Loeffler, an unassuming man who on this day sports a company tie emblazoned with "AMPHENOL." Loeffler is an Amphenol veteran who already has outlasted the two-year stints of a succession of presidents who preceded him. Whereas Loeffler is a connector industry insider, DeGeorge is a master of restructuring. DeGeorge "understands the business and is not an outsider to it. He is an enormous problem solver. It was the best thing to have happened to Amphenol to get it out of its lethargy," says Loeffler.

Perhaps so. Under new management, there has been a complete turnaround in two Amphenol divisions that were bleeding cash heavily before LPL bought them. With domestic sales of $6 million, the Fiber Optics group lost roughly $5 million in income yearly. Amphenol's French operations broke even on sales of $3.5 million yearly. LPL put both divisions on the auction block, fueling speculation that Amphenol would be sliced for its assets.

At the same time, though, DeGeorge slashed operating costs, eliminating the cash pouring into the Fiber Optics group's R&D work on optical integrated circuits. Flooded with expensive "research tools and Ph.D.s," recalls Dickson, the group "was a paperless office with no profits and overhead of $5 million." Both divisions now are pulling in average profits, relative to the company's 19 profit centers.

The two divisions weren't the only operations to feel DeGeorge's hand. After the LBO, Amphenol decentralized operations, a restructuring that Loeffler says took $30 million out of selling and administrative costs by eliminating operational layers.

Loeffler attributes a 10% increase in domestic sales to the reorganization. Under Allied, a centralized force pitched some 500,000 part numbers. With responsibility for a broad range of products, sales reps were hard pressed to work with customers at the design phase. "Our salesforce was just geared up to make a quick shot at the customer and get a quick sale," admits Loeffler. Sales to OEMs, now 54%, were diminishing quickly, "the clearest indication of a non-innovative company," says Dickson.

Amphenol's Bendix line claims a hefty 22% of the worldwide military connector business

At a decentralized Amphenol, a customer could be approached by representatives from each of six product lines. Amphenol also expanded its 50-member direct salesforce with some 250 manufacturing reps. For big accounts, Amphenol appointed 25 key account managers worldwide to maintain their access to broad product lines.

Decentralization was meant to cut the organizational layers in the path to the customer. But once implemented, it left customers in turmoil. "Right after the acquisition, it was a nightmare. You never knew who to call, where they were, and they didn't know what was happening," recalls distributor Aztech's Mortfeld. After about six months, service and delivery times improved, she adds.

Analogous with Wang

The experiences at Wang were similar. "Things fell apart. It was very uncomfortable and unproductive doing business with Amphenol. We started looking at other companies with a one-person [sales] focus," says Wang's Peters.

"We kept talking with them and telling them we needed a person with a central focus to talk to Wang," he adds. For about nine months, Wang and Amphenol quibbled until Amphenol assigned a key account manager to the Lowell, Mass., company. Meanwhile, Amphenol slipped from Wang's No. 2 connector supplier to No. 6, says Peters. (Amphenol says it sold Wang $1.4 million of products in 1985, increased business to $3.4 million in 1987, with sales down to $2.4 million in 1988, partly because of Wang's decreased sales.)

Loeffler responds that during the reorganization, Wang was almost a test case in learning to sell to big accounts. "It took us longer to realize. Other accounts didn't feel the same as Wang. We used that as a model for the rest to implement key account management."

Amphenol's pricing, however, may yet negate the company's efforts to improve customer service: customers still consider its products pricier than the competition's. Northern Telecom reports that because some Amphenol parts can be 15% more than competitors', Amphenol "lost ground to price," says Pols.

Amphenol and its competitors

(1988 fiscal year figures)	Amphenol	AMP	Molex
Sales ($ millions)	$467*	$2,670	$502
Sales growth (from 1987)	+7.2%	+15.0%	+29.9%
Operating income ($ millions)	$48	$530	$102
Operating income/sales	10.4%	19.8%	20.3%
Pre-tax return on sales	15.0%	19.8%	20.5%
International sales/sales	33%	54%	71%
Capital expenditures/sales	4.0%	8.2%	13.7%
R&D/sales	5.0%	8.9%	5.4%
Selling, general and administrative expenditures/sales	14.0%	17.4%	27.4%

* Excludes revenue of affiliates and joint ventures

Source: Company reports

Because Amphenol derives 34% of its revenue from the military, its R&D costs and capital expenditures are typically lower than those of competitors in the commercial connector arena.

Distributors also say Amphenol is inflexible in pricing for certain parts. Loeffler defends his distributor price structure: "They just want to get an order, but we have to give up margin, not the distributor. And that would not be a win-win situation."

"If the leader doesn't increase prices where we are strong, if we don't lead the market in some of the pricing issues, we'll just have the continued erosion of prices," he adds.

On other fronts, Amphenol is changing how it brings products to the market. To reduce total product cost, Amphenol is rationalizing "where we should source products to make us the lowest-cost producer from a global standpoint," says Loeffler. Amphenol has plowed 7.2% of revenue into capital expenditures, largely for CAD, automated assembly machinery and statistical process control, into its seven operating units in North America.

Internationally, Amphenol's product cost reduction strategy has been to build smaller, more flexible facilities of 30,000 to 50,000 square feet, replacing the 100,000 to 200,000 square-foot plants of Amphenol's past. Says Dickson: "With the fluctuation in the dollar, we're going to all types of exotic places. You can't have one great big plant in York, Pa., supplying all over. We need the flexibilty to move with our customers." To capitalize on lower manufacturing costs, for example, Amphenol recently shifted production from Taiwan to Thailand.

Amphenol also is weighing plans for a unified Europe in 1992, acting now "or risk losing significant market share," says Dickson. Last year, 33.1% of revenue was foreign. Amphenol may build a major facility overseas, and is fishing for agreements with multinational technology leaders.

Loeffler says improvements in production include:

- A 40% reduction in new product introduction time
- A 20%-to-60% reduction in cycle times, depending on product line
- A 33% reduction in leadtimes in the RF division
- A 50% reduction in leadtimes in German and British operations.

By year-end, Loeffler expects Amphenol to cut company-wide leadtimes by one-half, and again by another 20% by 1990. On-time delivery, now 60%, should hit 85% by year-end, and 90% by 1990.

Overall, customers and distributors give high marks to good leadtimes and product introductions for the RF and Spectra-Strip lines. "RF has improved tremendously. They're more receptive, there are new products, and better delivery," says distributor Aztech's Mortfeld.

David Goforth, a vice president for connector marketing with distributor Sterling Electronics Corp. in Dallas, says that after the reorganization its sales from Amphenol, once flat, increased by 11%. "We've done very well on the Amphenol line."

At the industrial technology division, "We were less than satisfied, but they've made the fixes. We've got to start seeing the results," says Terry Diedrich, a marketing vice president at Dallas-based distributor Hall-Mark Electronics Corp. "It was poor a while back. Can I give them a good rating yet? Nope."

Amphenol's pricing practices may yet negate the company's efforts to improve customer service

At Bendix, leadtimes rocketed to 18 to 20 weeks in 1988 as Amphenol consolidated operations. They are now down to eight to 12 weeks for military products, and six to eight weeks for commercial lines.

Arthur Nanos, president and chief executive of Powell Electronics Inc., a Philadelphia distributor that derives one-third of its revenue from Bendix, says "delivery has improved. Quality had some problems but is now improving." Amphenol's challenge now, he adds, is "to place emphasis on new products." (Amphenol is investing in two important military products: the composite connector, for which Loeffler estimates there exists an $8 million market worldwide, and the brush connector, a $6 million market. Amphenol faces stiff competition for both these products.)

Amphenol is trying to hook customers with improved worldwide JIT and ship-to-stock in the military and aerospace market. Loeffler's goal is to become a low-cost supplier by reaching four-week leadtimes and delivering 95% on time.

Loeffler also is trying to woo customers with new products. In 1987, Amphenol generated 7% of revenue from new products introduced during the past two years, a figure Loeffler expects will jump to 10% in 1989. The company hasn't increased its R&D budget — 5% of sales — since the LBO. Instead, it reallocated to product development 3.5% of revenue realized from lowering manufacturing costs. By modifying manufacturing methods and adding CAD, Loeffler says product introduction times have been sliced in half, down from one to two years.

To fill in target niches in its product line, Amphenol will use a $1 billion credit line from LPL for acquisitions of companies sized at about $150 million to $300 million in revenue. In June, LPL announced the $62.5 million purchase of two connector groups from BRIntec Corp. Acquisitions should patch some holes in the company's commercial product offerings. "Amphenol hasn't done well on commercial product lines. It spent $20 million on 'me-too' products and lost $1 million in sales. We have strengths in several niches, with $200 million in commercial market sales," says Loeffler. The company is particularly weak in I/O connectors and high-density IDC connectors, he says.

Some in the industry, however, are skeptical of Amphenol's R&D effort. "I rarely see Amphenol in our new products," says Pols of Northern Telecom. "When it comes to product innovation, it's hard to compete against AMP and DuPont."

"They lost their technology edge with the LPL acquisition," adds Wang's Peters. "It took them some time to get it back. The visibility is not there." Loeffler responds that because of the company's weakness in the board business, customers might not see new products there until Amphenol makes an acquisition.

After a rough two-year transition, Amphenol might be on the mend. President Loeffler will need all the aggressiveness he can muster against the competition and to convince customers the "new" Amphenol has arrived. "From a procurement point of view," says Northern Telecom's Pols, "the dust hasn't settled." □

Electronics financiers prefer to play it safe

The news is bad for entrepreneurs seeking early- or middle-stage funding, as LBO-minded venture capitalists focus on less risky, mature companies

BY RAY WISE

Venture capital has been bitten by the leveraged buyout (LBO) bug, and that is bad news for electronics entrepreneurs who are seeking early- or middle-stage financing.

Stung by declining investment returns on their earlier stage deals, some venture capitalists have turned to backing established high-tech companies as a way to reduce risk and speed paybacks. The shift coincides with the growing recognition that solidly profitable electronics ventures can be financed prudently with debt. Thus the two forces have spurred the use of "leveraged venture capital," the electronics industry's version of the leveraged buyout.

"LBO financing is increasing," says Lindsay Jones, an editor at Venture Economics Inc. in Needham, Mass. Industry statistics now being compiled by the publishing and research firm are likely to show a clear, two-year uptrend in leveraged buyout deals that include venture capital participation. About 24% of the newest fund of Hambro International Venture Fund in New York City, with a $30 million, 20 company portfolio, consists of LBOs, compared with well under 10% a couple of years ago, says Edwin A. Goodman, managing partner.

In September 1988, Hambro financed 80% of a $6 million buyout of Avatar Corp., Hopkinton, Mass., a 7-year-old supplier of connectivity products seeking to expand its share of the Macintosh-to-mainframe market. The management team of Thomas F. Bogan, president of Avatar, led the buyout of the company from a Dutch investment firm, Oranje Nassau Groep in The Hague, and put up 20% of the deal. The financing was roughly half equity, half debt, which is a lot of leverage by high-tech standards, but piddling in the LBO world, where 80% or 90% debt financing is commonplace.

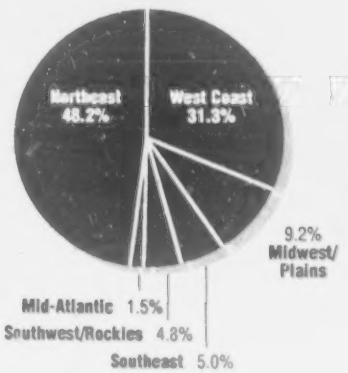
What is typical about the transaction is that Avatar is a turnaround situation, which often sparks corporate restructuring. Having weathered a sea of troubles, the company, under Bogan, turned profitable in late 1987 for the first time and is profitable now. Revenue is forecast to reach $10 million this year.

Yet Avatar differs markedly from the companies that traditionally have been targeted for LBOs by the financial community — moderately growing companies with prosaic product lines and torrential, predictable cash flow, the food and tobacco blend of the RJR Nabisco deal being a textbook case. Unlike the Wall Street financiers who pull off the big buyouts that drive the stock market, venture capitalists understand high-tech and are not cowed by it. Some of them challenge the conventional view that leading-edge companies should not

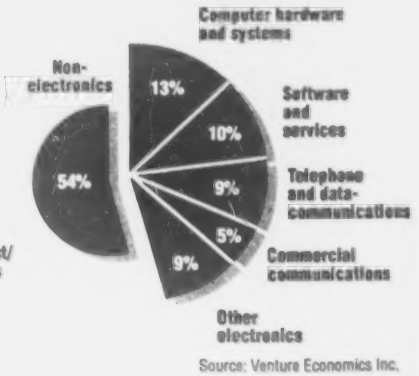
Venture capital: How much is available and where it is going

Total dollars committed
($ billions)

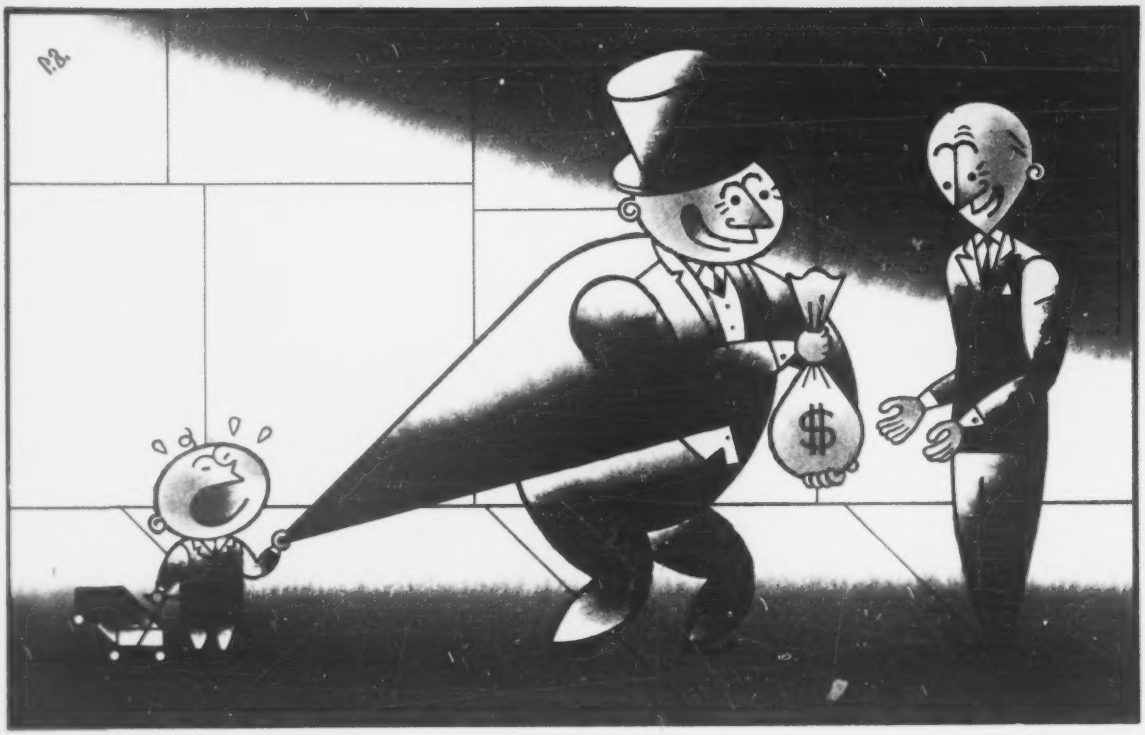
Breakdown by region
1988



Breakdown by industry
1988



Source: Venture Economics Inc.



Phillip Anderson

be heavily leveraged. They say debt is acceptable as long as corporate cash flow can service it and there is enough left over to support R&D and the marketing push.

Bypassing equity markets

The stock market's shabby treatment of high tech makes leverage cheaper than ever. "The LBO is a way to bypass the equity markets," says DuBose Montgomery, a general partner in Menlo Ventures, Menlo Park, Calif., who points out that a company taken out by an LBO eventually can be sold to another LBO team. This process works fine until interest rates go through the roof. Meanwhile, its victims are young high-tech companies trying to get off the ground, says Fred M. Haney, senior vice president of 3i Ventures Corp., Newport Beach, Calif. "The LBO is draining capital from early-stage companies," Haney says.

Middle-stage ventures may be the hardest hit. While many venture funds are dedicated and committed to early-stage deals or mezzanine funding, few specialize in second-and third-round financing. Moreover, some venture capitalists say middle-stage deals are much costlier than start-ups without being significantly less risky.

Data on venture capital's portfolio performance is hard to come by, but Hambro's Goodman figures the industry's annual investment returns have tumbled to single-digit levels from 20% to 25% in the 1970-1980 period. One contributor to the erosion of performance is the current tendency of entrepreneurs to stay under the wings of their venture capitalists longer, like adult children who still live with their parents because they can't afford their own housing. The venture capital nurturing cycle has expanded from three to five years in heady 1983 to five to seven years now, according to Mark L. Radtke, vice president of Advent International Corp. in Boston.

The stock market's treatment of high tech makes leverage cheaper than ever

Intense competition in parts of the high-tech marketplace causes some emerging companies to fall a year or two behind their business plan targets. The problem is greatest, according to Haney, among manufacturers of disk drives, laptops, personal computers, printers, peripherals and telecommunications products. "These are pretty crowded places. Companies have to work harder and longer to get to profitability."

High-tech entrepreneurs also must work harder and longer to go public, reflecting the poor pricing, extreme selectivity and shrinkage of the initial public offering market, which brought out only 36 venture-backed companies in 1988. This is down sharply from 81 in 1987 and 121 during the 1983 boom. In contrast, acquisitions of venture-backed companies nearly tripled to 135 in 1988 from only 49 in 1983. Stephen Woodsum, managing partner of Summit Partners in Boston, estimates that recently nearly half of Summit's portfolio companies exit via mergers and acquisitions.

Financially, the M&A route can be highly rewarding to the electronics entrepreneur. "A company worth $100 million in the public market would bring $200 million in a sale," says Arthur Spinner, a Hambro general partner. Among the reasons why market forces do not close the gap are the "control premiums" buyers are willing to pay for a company's reins, and the irreducible cost of purchasing its fixed assets and people. It takes $35 million, just for openers, to finance a semiconductor supplier, says Goodman; a selling venture capitalist would demand at least five times that amount.

Yet some entrepreneurs would readily settle for a smaller payoff to keep control of their firms. "By going

public, the entrepreneur gains all the advantages. Being public creates credibility with customers. It says the company is going to be around for a while," says Michael Dolbec, associate partner in Kleiner Perkins Caufield & Byers, Palo Alto, Calif.

The stretching out of the venture capital holding period is typified by Banyan Systems Inc. of Westboro, Mass. This 6-year-old company is still private, although revenue in the first three months of fiscal 1989, ended March 31, was just under $20 million and earnings in the quarter soared 174%. The supplier of network operating system software and hardware announced this March its sixth round of private financing, structured with subordinated notes and warrants to buy common stock. Given its age, strong financials and painstaking preparation, Banyan stands a good chance of being well received when it finally does go public. "I have spent the last two and a half years educating the financial community to make sure the company is well understood," says David C. Mahoney, Banyan's president and chief executive officer.

While high-tech companies linger longer in the portfolios of venture firms, the firms take heat from institutional investors clamoring for faster returns. After all, no one is paid until the emerging company goes public or sells out. To get around this problem, some venture capitalists focus more and more on later-stage financing, even if they don't do LBOs. "It's very rough to find patient money," says Goodman.

Not only does the shift to more mature firms drain capital from younger companies, it also absorbs management time at the venture firms. "We used to spend one-third of our time looking at first-round deals. Now it's down to one-quarter," says Mike Shanahan, partner in Eastech Management Company Ltd., Boston. Shanahan worries that a slowdown in IPOs might produce a chain reaction by robbing would-be entrepreneurs of their role models. He points out that newly public companies can inspire salaried engineers and scientists to think about launching their own ventures. "They say to themselves, 'If he did it, so can I, and I might make $5 million,' " Shanahan says.

In addition, high-tech salaries have climbed high enough to function as

gold handcuffs, keeping even the most ambitious and creative individuals chained to their jobs. Six-digit earners, formerly a rarity, now are so common that several are to be found among the 20-odd companies in the Eastech portfolio.

Despite dismal conditions in the IPO market, a few venture-backed companies have been going public. One such company is Goal Systems International Inc. of Columbus, Ohio, a portfolio company of Advent International in Boston and a supplier of mainframe software. Goal came out in early May, helped by awesome financials showing earnings

Some entrepreneurs would settle for a smaller payoff to keep control of their firms

of 60 cents a share, on revenue of $52.2 million in fiscal 1989 ended last January 31. This compares with 28 cents a share on revenue of $13.3 million in fiscal 1985.

Equally impressive is the balance sheet, which, adjusted for the IPO, lists total assets of $76.1 million, working capital of $39.9 million and stockholders' equity of $47.6 million. "That was a 'lay-up,' and you don't find many lay-ups these days," says Patrick J. Sansonetti, a senior partner of Advent and one of the venture capitalists evincing heightened interest in LBOs and other later-stage financings.

Corporate partnering

Younger, less seasoned companies, meanwhile, that are stalled on their way to the public securities market are coming up with ingenious ways of snaring dollars and reducing the financial pressure on their venture capitalists. One method of gaining rapid acceptance is corporate partnering, in which the venture sells a small piece of itself to a deep-pocketed big brother in a technology transfer or marketing rights deal.

Advent's Radtke, a former Venture Economics staffer, reports that the number of such arrangements swelled from 219 in 1983 to 477 in 1987 and says that 1988 probably saw yet another increase. The partnering trend parallels the internationalization of the electronics and venture capitalist industries, as evidenced by a transaction completed in April by a Hambro portfolio company. Goodman reports that Mathsoft Inc. of Cambridge, Mass., signed a distribution agreement with a division of C. Itoh, a major Japanese trading firm.

At the same time, venture firms that are sticking with high-tech and sticking with early-stage deals — some of the nondedicated funds have diversified into other industries such as specialty retailing — have altered their strategies to fit the tougher marketplace. For example, 3i Ventures increasingly focuses on syndicated financing of early-stage deals, in part to assure help with later-stage rounds.

3i Ventures has gone it alone in the past, only to experience difficulty obtaining back up later on, senior vice president Haney reports; so the strategy now is to bring in co-investors, even in very small transactions, to enhance 3i's marketing and technological know-how as well as its financial resources.

Kleiner Perkins devotes more time than ever before to early-stage deals and stays very close to the entrepreneurs who enter its fold. Some of the would-be CEOs are even given office space and secretarial services in Kleiner Perkins' Palo Alto, Calif., office, where they undergo a sort of incubation period. They receive help networking into product distribution and other assistance. "They can walk down the hall and ask advice," says associate partner Dolbec, stressing

I don't know doctor, ever since we've made this acquisition, I've been seeing double!!
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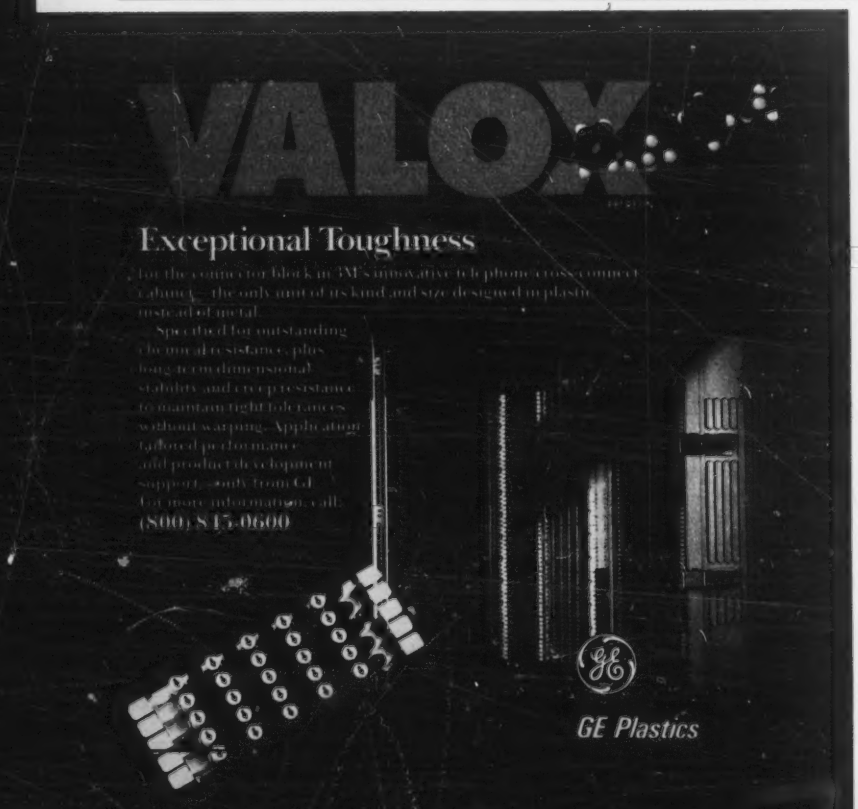

that this is value added by the venture firm. "Anybody can just write a check."

Early-stage financiers increasingly are applying rigorous standards to the products and entrepreneurs they back. They look for quantum improvements in price performance and tenfold enhancements, because if they settle for less, the technology soon will be topped by some other venture firm's entrepreneur. Anything that the Japanese are good at is an almost automatic turnoff.

Moreover, notes Tom Stark, vice president in the Boston office of 3i Ventures, "The hardware business is going to be difficult to fund unless the product is really unique." Stark likes industrial automation, which has been toned down considerably from its early preoccupation with robotics and now focuses on automation of manufacturing and processing. Thus, 3i Ventures invested more than $2 million in five start-up and early-stage IA companies in the first three months of 1989.

Entrepreneurs are being scrutinized by venture capital firms in terms of their personal characteristics

Highly favored by Michael Moritz, partner in Sequoia Capital, Menlo Park, Calif., is the networking business, which he views as a wave that venture capital can ride almost indefinitely. He also likes the programmable logic market. "We are as busy as ever in the early-stage financing, looking at exciting and interesting propositions. We also are active in the later-stage area," Moritz reports.

Despite intense rivalry in the hardware marketplace, Dolbec of Kleiner Perkins is enthusiastic about portable, easy-to-use computers, which he sees as the wave of the future.

Other criteria also affect a company's chances of receiving the gold seal of approval from venture capitalists. Warburg Pincus Ventures Inc., New York City, sizes up high-tech funding deals in terms of management, markets and technology, in

90

that order, on the grounds that there is a lot more technology available than there are entrepreneurs able to market it successfully. Also, "A venture can improve its chances of being funded by including international expansion in its business plan, along with corporate partnering," says Radtke of Advent.

Entrepreneurs are being closely scrutinized by venture capital firms in terms of their personal characteristics. Spinner of Hambro looks for leadership potential, good communication skills, and the ability to move comfortably in international circles. He wants a CEO who can smoothly give a presentation to 600 security analysts and bowl them over.

Given the perils of investing in high-tech, one worry might be that it eventually will be abandoned by the venture capital industry. But Goodman of Hambro is reassuring on this point, stressing that his firm will uphold its commitment to technology while seeking to boost its investment returns by injecting capital into other industries. If for no other reason than that, three of Hambro's four most profitable investments have been high-tech companies: Corporate Software Inc., Westwood, Mass.; Komag Inc., Milpitas, Calif.; and Telematics International Inc., Fort Lauderdale, Fla.

Shanahan stresses that the best thing for venture capital and the high-tech companies it supports would be a turnaround in the IPO market. Moritz says this is already happening, thanks to the recent climb in equity prices generally. "The nightmares of the last year or so have been forgotten in the current jubilation," Moritz says.

Somewhat less optimistic about the near-term outlook for the stock market and for the venture capital industry is Montgomery of Menlo Ventures, who hopes for a restoration of favorable tax treatment of capital gains as a strong stimulant to high-tech share prices.

Individual investors, historically technology's most loyal supporters, would be lured back to the stock market in droves if the tax change were enacted, Montgomery predicts. He doubts that his industry's near-term trials are over, but his longer-term view is highly positive, encompassing "a resurgence of venture capital and its return to strong profitability." □

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Who's who in venture capital

Results of the ELECTRONIC BUSINESS survey of venture capitalists that serve the electronics industry

1988 figures

Company/address	Contact	Telephone	Total paid-in capital ($ millions)	Dollar investment ($ millions)		Number of companies invested in:	
				Total	Electronics	Total	Electronics
Accel Partners 1 Palmer Square, Princeton, N.J. 08542		(609) 683-4500	NA	NA	NA	NA	NA
Adler & Company 375 Park Avenue, Suite 3303, New York, N.Y. 10152		(212) 759-2800	NA	NA	NA	NA	NA
Advent International Corp. 101 Federal St., Boston, Mass. 02110	Thomas H. Lauer	(617) 951-9400	$400	$75	$28	60	14
Asset Management 2275 E. Bayshore Rd., Suite 150, Palo Alto, Calif. 94303	Tony Di Bona	(415) 494-7400	$72	$46	$17	56	21
BancBoston Capital Inc. 100 Federal St., Boston, Mass. 02110	Frederick M. Fritz	(617) 434-2509	$300	NA	NA	100	NA
BancBoston Ventures Inc. 100 Federal St., Boston, Mass. 02215	Jeffrey W. Wilson	(617) 434-2442	NA	$29	$7	35	10
Battery Ventures 200 Portland St., Boston, Mass. 02114	Richard D. Frisbie	(617) 367-1011	$76	$10	$10	12	12
Brentwood Associates 11661 San Vicente Blvd., Suite 707, Los Angeles, Calif. 90049	G. Bradford Jones	(213) 826-6581	$433	$39	$16	39	15
Charter Venture Capital 525 University Ave., Suite 1500, Palo Alto, Calif. 94301	A. Barr Dolan	(415) 325-6953	NA	NA	NA	50	25
Chatham Venture Corp. 420 Bedford St., Lexington, Mass. 02173	Euan C. Malcolmson David F. Millet	(617) 863-0970	$23	$14	$14	12	12
Citicorp Venture Capital Ltd. 153 E. 53rd St., 28th floor, New York, N.Y. 10043	Thomas C. Darling	(212) 559-1239	NA	NA	NA	54	27
Cornerstone Ventures 2420 Sand Hill Road, Suite 202, Menlo Park, Calif. 94025	Barbara Anderson	(415) 854-2576	$37	$20	$4	53	1
Crosspoint Venture Partners One First St., Los Altos, Calif. 94022	William P. Cargile	(415) 948-8300	$120	$64	$42	48	31
Dajen Consulting Corp. 9 Lundy Lane, Larchmont, N.Y. 10538	Robert Cohen	(914) 834-5910	NA	NA	NA	NA	NA
Dougery, Jones and Wilder 2003 Landings Drive, Mountain View, Calif. 94043	John R. Dougery	(415) 968-4820	$130	$60	$42	36	23
Eastech Management Company Ltd. 260 Franklin St., Suite 530, Boston, Mass. 02110	Michael H. Shanahan	(617) 439-6130	$34	$26	$26	21	21
Euclid Partners Corp. 50 Rockefeller Plaza, New York, N.Y. 10020	Frederick Wilson	(212) 489-1770	$49	$17	$14	15	11
Fairfield Venture Partners 1275 Summer St., Stamford, Conn. 06905	Eugene E. Pettinelli	(203) 358-0255					
650 Town Center Drive, Suite 810, Costa Mesa, Calif. 92626	Randall R. Lunn	(714) 754-5717	$100	$54	$31	48	24
First Century Partners 1345 Avenue of the Americas, 47th floor, New York, N.Y. 10105	Lisa Roumell	(212) 698-3634	$150	$90	$40	24	10
Fortech International Ltd. 8615 Wild Olive Drive, Potomac, Md. 20854	Dr. L. Wasserman	(202) 898-9795	NA	NA	NA	NA	NA

(Continued)

1988 figures Company/address	Contact	Telephone	Total paid-in capital ($ millions)	Dollar investment ($ millions) Total	Electronics	Number of companies invested in: Total	Electronics
Grace Ventures Corp. 20300 Stevens Creek Blvd., Suite 330, Cupertino, Calif. 95014	Christian Horn	(408) 725-0774	$70	$47	$27	44	25
Hambrecht & Quist Venture Partners 225 Montgomery St., San Francisco, Calif. 94104		(415) 576-3300	NA	NA	NA	NA	NA
Hambro International Venture Fund 17 East 71st St., New York, N.Y. 10021	Julie Lane	(212) 288-7778	$150	$85	$29	72	19
Idanta Partners 201 Main St., Suite 3200, Fort Worth, Texas 76102	Dev Purkayastha	(817) 338-2020	$80	$80	$40	13	10
Indosuez Ventures 3000 Sand Hill Road, Building 4, Suite 100, Menlo Park, Calif. 94025	David E. Gold	(415) 854-0587	$34	$18	$8	34	15
Intersouth Partners P.O. Box 13546, Research Triangle Park, N.C. 27709	Joseph A. Velk	(919) 544-6473	$25	$6	$3	11	5
Interwest Partners 3000 Sand Hill Road, Building 3, Suite 255, Menlo Park, Calif. 94025	Charles McMinn	(415) 854-8585	$155	$23	NA	NA	NA
Kleiner Perkins Caufield & Byers 2200 Geng Rd., Palo Alto, Calif. 94303		(415) 424-1600	NA	NA	NA	NA	NA
Lambda Funds/Drexel Burnham Lambert 60 Broad St., 7th floor, New York, N.Y. 10004	Alexandra Mahnken	(212) 232-8425	$40	$46	$23	47	19
Lawrence, Tyrrell, Ortale & Smith 515 Madison Ave., New York, N.Y. 10022	Brian T. Horey	(212) 826-9080	$68	$40	$14	30	10
Mayfield Fund 2200 Sand Hill Road, Menlo Park, Calif. 94025	Glenn M. Mueller	(415) 854-5560	$34	$34	$24	36	25
Menlo Ventures 3000 Sand Hill Road, Building 4, Suite 100, Menlo Park, Calif. 94025	H.D. Montgomery	(415) 854-8540	$285	$24	$13	28	20
Merrill Lynch Venture Capital 717 5th Ave., 22nd floor, New York, N.Y. 10022	Kelly M. Pan	(212) 980-0462	$180	$100	$40	60	25
Merrill, Pickard, Anderson & Eyre 2 Palo Alto Square, Suite 425, Palo Alto, Calif. 94306	W. Jeffers Pickard	(415) 856-8880	$180	$150	NA	70	NA
Mohr, Davidow Ventures 3000 Sand Hill Road, Building 1, Suite 240, Menlo Park, Calif. 94025	Michael Sears	(415) 854-7326	$80	$34	$14	36	17
Morgan Holland Ventures One Liberty Square, Boston, Mass. 02109	J.T. McCullen Jr.	(617) 423-1765	$100	$4	$1	4	2
Morgenthaler Ventures 700 National City Bank Building, Cleveland, Ohio 44144	T.A. Laufik	(216) 621-3070	$100	$53	$18	44	8
New Enterprise Associates 1119 St. Paul St., Baltimore, Md. 21202	Nancy Dorman	(301) 244-0115	$400	$282	$225	160	128
Oak Investment Partners 1 Gorham Island, Westport, Conn. 06880	Michele Cassidy	(203) 226-8346	$335	$156	NA	137	100
Pathfinder Venture Capital Funds 7300 Metro Blvd., Suite 585, Minneapolis, Minn. 55435	Brian P. Johnson	(612) 835-1121	$73	$53	$26	50	23
Raytheon Ventures 141 Spring St., Lexington, Mass. 02173	Clyde E. Rettig	(617) 860-2274	$26	$26	$12	11	6
SAS Associates 515 S. Fugueroa St., Los Angeles, Calif. 90071	J.M. Christiansen	(213) 624-4232	NA	NA	NA	NA	NA

(Continued)

1988 figures Company/address	Contact	Telephone	Total paid-in capital ($ millions)	Dollar investment ($ millions) Total	Electronics	Number of companies invested in: Total	Electronics
SRB Management Co. 13455 Noel Road, Suite1670, Dallas, Texas 75240	Jon Bayless	(214) 702-1100	$65	$15	$15	10	10
Sequoia Capital 3000 Sand Hill Road, Building 4, Suite 280, Menlo Park, Calif. 94025	Don Valentine	(415) 854-3927	$300	$200	NA	150	NA
Sevin Rosen Bayless Borovoy 13455 Noel Road, Suite 1670, Dallas, Texas 75240	Dennis Gorman	(214) 702-1100	$150	$100	$100	50	50
Shaw Venture Partners 111 S.W. 5th Ave., Suite 2200, Portland, Ore. 97204	Alan Dishlip	(503) 228-4884	$50	$17	$14	22	17
Sigma Partners 2099 Gateway Place, Suite 310, San Jose, Calif. 95110	Clifford L. Haas	(408) 453-9300					
300 Commercial St., Suite 705, Boston, Mass. 02109	Gardner C. Hendrie	(508) 393-7396	$44	NA	NA	NA	NA
Southern California Ventures 9920 La Cienega Blvd., Suite 510, Inglewood, Calif. 90274	B. Allen Lay	(213) 216-0544	$45	$23	$10	22	5
Summit Partners One Boston Place, Boston, Mass. 02108	Bradley O. Greene	(617) 742-5500					
4675 MacArthur Court, Newport Beach, Calif. 92660	Philip D. Black	(714) 476-2700	$391	$150	$90	54	33
Sutter Hill Ventures 2 Palo Alto Square, Suite 700, Palo Alto, Calif. 94306	Paul M. Wythes	(415) 493-5600	$100	$11	$11	8	8
3i Ventures Corp. 450 Newport Center Drive, Suite 250, Newport Beach, Calif. 92660	Fred Haney Randall Crawford	(714) 720-1421	$200	$145	$100	110	60
99 High St., Boston, Mass. 02110	Allan Ferguson Connor Seabrook	(617) 542-8560					
TA Associates 45 Milk St., Boston, Mass. 02109	Arthur Epker Kenneth T. Schiciano	(617) 338-0800	$226	$61	$47	42	33
435 Tasso St., Palo Alto, Calif. 94301	Michael C. Child	(415) 328-1210					
TVM Techno Venture Management 45 Milk St., Boston, Mass. 02109	Waldemar Jantz	(617) 574-6706	$150	$75	$20	50	15
Trinity Ventures Ltd 20813 Stevens Creek Blvd., Suite 101, Cupertino, Calif. 95014	Noel J. Fenton	(408) 446-9690	$33	$25	$21	22	18
U.S. Venture Partners 2180 Sand Hill Road, Suite 300, Menlo Park, Calif. 94025	Steven M. Krausz	(415) 854-9080	$338	$224	$73	111	44
Venture Capital Fund of New England 160 Federal Street, 23rd floor, Boston, Mass. 02110	Karen Reiche	(617) 439-4646	$35	$7	$2	19	4
Venture Funding Group 49 W. 12th St., Executive Suite, New York, N.Y. 10011	Allan E. Skora	(212) 691-9895	NA	$9	$5	6	3
Warburg, Pincus Ventures 466 Lexington Ave., New York, N.Y. 10017	William H. Janeway	(212) 878-9387	$1,620	$1,400	$106	81	19
Woodside Fund 850 Woodside Drive, Woodside, Calif. 94062	Craig L. Davidson	(415) 368-5545	$30	NA	NA	12	7
Xerox Venture Capital 800 Long Ridge Road, Stamford, Conn. 06904	L.J. Harris	(203) 968-4155	$100	$50	$35	34	NA

(Continued)

U.S. electronics firms venture capitalists are funding

Results of the ELECTRONIC BUSINESS survey of venture capitalists that serve the electronics industry

Advent International: Aspen Technology, Verifone, Halley Systems
Asset Management: Inova Microelectronics, Performance Semiconductor, Sierra Semiconductor
Battery Ventures: Banyan Systems, Network Management, Business Software Technology
Charter Venture Capital: Metricom, Supertelc Computer, InterFox
Chatham Venture: Banyan Systems, Telesoft, Applix

Citicorp Venture Capital: Acer Group, Proteon, Asix Systems
Cornerstone Ventures: Ardent Computers, Digital Microwave, Performance Semiconductor
Crosspoint Venture Partners: Photonics, Whitfield Communications, STAC
Dougery, Jones and Wilder: Excelan, FileNet, Integrated Telecom
Eastech Management: Banyan, Aries Technology, Vicor

Euclid Partners: Xylogics, Banyan Systems, Read-Rite
Fairfield Venture Partners : Ardent Computer, Cadre Technologies, Summagraphics
First Century Partners: Prime Computer, WaferScale Integration, Valid Logic Systems
Grace Ventures: IXYS, Micro Linear, Interlink Electronics
Hambro International Venture Fund: Telematics, Komag, IDE Associates

Indosuez Technology Group: Cisco Systems, Synergy Semiconductor, Sierra Semiconductor
Intersouth Partners: Integrated Silicon Systems, Digital Recorders, Imsatt
Interwest Partners: Radius, Convex Computer, Xilinx
Lawrence, Tyrrell, Ortale & Smith: Sabert Software, ViaSoft, Antrim
Mayfield Fund: Mips Computer Systems, Synergy Semiconductor, Silicon Graphics

Menlo Ventures: Synoptics Communications, Octel Communications, Microcom
Merrill Lynch Venture Capital: Telecom U.S.A., Qume, Everex Systems
Merrill, Pickard, Anderson & Eyre: Cypress Semiconductor, Network Equipment Technologies, Maxim Integrated Products
Mohr, Davidow Ventures: MIPS Computer Systems, Echelon, Insite Peripherals
Morgenthaler Ventures: Verifone, Censtor, Intelledex

New Enterprise Associates : Convex Computer, Dallas Semiconductor, Silicon Graphics
Oak Investment Parnters: Sybase, International Customer Solutions, Vitesse
Pathfinder Venture Capital Funds: Computer Accessories, Digital Systems International, Emerald Systems
Raytheon Ventures: Bipolar Integrated Technology, Sciteq Electronics, Beta Phase
SRB Management: Retix, Optilink, Shared Resource Exchange

Sequoia Capital: Vitesse Semiconductor, Cisco Systems, MasPar
Shaw Venture Partners: Actel, Sequent Computer Systems, Protocol Systems
Sigma Partners: FileNet, Octel Communications, Phoenix Technologies
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Sutter Hill Ventures: Weitek, Banyan Systems, Relations Technology

3i Ventures: Netframe Systems, Sierra Semiconductor, Silicon Power
TA Associates: Novellus Systems, PrairieTek, Epoch Systems
TVM Techno Venture Management: Novellus Systems, Cadre Technologies, Digital Research
Trinity Ventures: Vitalink Communications, Conner Peripherals, Alldata
U.S. Venture Partners: Sun Microsystems, Ultron Labs, Analog Design Tools
Woodside Fund: Orion Instruments, Quantitative Technology, Syquest Technology

Multinational workforces on the rise in Japanese firms

As Japan's major electronics companies are shifting more production offshore to counter the high yen, they must cope with 30% to 50% non-Japanese workers

PAULA DOE

Internationalization isn't just a buzzword anymore in Japan. Scrambling to counter the high yen, major Japanese electronics companies have moved some 15% to 30% of their total production offshore in the past several years. That has created a workforce that's 30% to 50% non-Japanese.

Ready or not, Japan's big electronics exporters have become multinational companies. Now the task is to figure out how to make it work.

Currently, half or more of the workers at major Japanese electronics companies — including Alps Electric Company Ltd., the Sanyo Electric Company Ltd. group and Sharp Corp. — are not Japanese. And Canon Inc. expects two out of every three of its employees will be outside of Japan within 10 years.

One basic first step toward becoming a global company is to reorganize the corporate structure to give local operations more autonomy. In a rush of enthusiasm for regional control, Matsushita Electric Industrial Company Ltd., Mitsubishi Electric Corp., NEC Corp., Sanyo, and Toshiba Corp. have all reorganized their foreign operations in recent months.

Most Japanese overseas operations traditionally have been sales or manufacturing branches of particular product divisions: the television group set up television factories abroad; the semiconductor group assembled integrated circuits overseas. Executives in the product group in Japan called the shots, working through plant managers and sales managers sent from Japan. Units of different product groups often had little to do with one another. But the trend this year is toward establishing regional corporate headquarters in North America, Asia and Europe to take charge of all activities in their respective areas.

Mitsubishi's latest tactics, for example, call for building autonomous companies abroad. "Our overall view of world trade is that, quite against everyone's expectations, there will be a U.S.-Canada bloc, a European bloc, and an Asian bloc," explains Takeshi Sakurai, president of Mitsubishi Electric America Inc., in Washington, D.C. "These blocs are taking shape because of protectionism, so we have to create an organization to deal with that. There will be fewer transactions across the ocean. We will build autonomous R&D and manufacturing in each bloc. . . . It's a waste of time and money, but we believe it is going to happen."

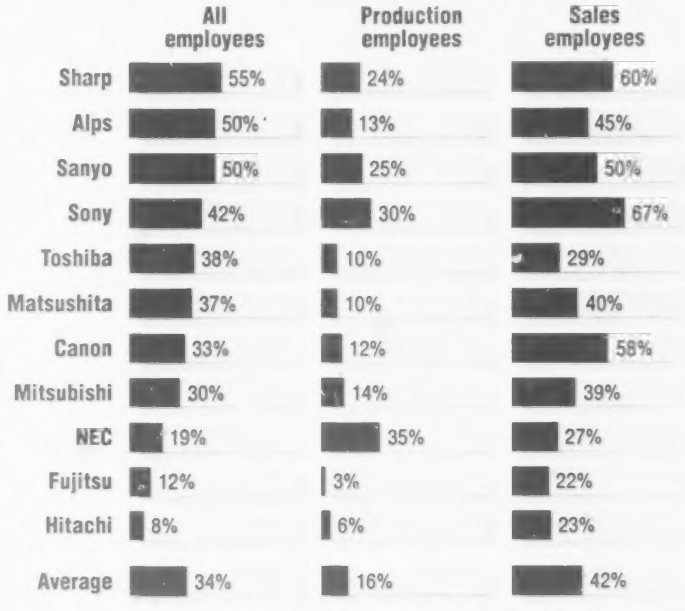
New U.S. headquarters

Toshiba, Matsushita, and Sanyo have also established new U.S. corporate headquarters units in recent months, to oversee all North American operations, and are working on the same arrangement in Europe and Asia. The regional headquarters will supply corporate staff for all units in law, finance, advertising, and the like.

Toshiba has also combined its scat-

Japan's growing foreign workforce

Non-Japanese employees as a percentage of total workforce



Source: *Nikkei Sangyo Shimbun*, ELECTRONIC BUSINESS

tered U.S. sales and manufacturing operations by product line, so each of five U.S. subsidiaries will now control both sales and manufacturing in its product area. All will report to a new U.S. corporate headquarters instead of their product groups in Japan, while the U.S. headquarters will report to a new high-level international division in Japan.

"It gives us a lot more independence," says a spokeswoman for Toshiba's U.S. consumer products business.

NEC is moving away from central control in a slightly different way, with a new tactic called "mesh globalization." Instead of trying to produce goods where they will be consumed, the company intends to locate production in the optimal place. This means semiconductors made in the United States may be assembled into products in Asia for sale in Europe. So managers in all these locales will have to deal more directly with one another, without going through Tokyo all the time, and reportedly will have more authority.

All this should be good news for local management. Non-Japanese nationals were automatically relegated to a relatively low corporate level when foreign operations were simply a minor arm of a Japanese product group. Even the Japanese executives in charge overseas were fairly low in the corporate hierarchy. But senior positions in a U.S. headquarters are another matter. If regional units really are given significant autonomy, it is easier to imagine non-Japanese eventually taking larger roles in local management.

Sony, long among the most internationally oriented of the major Japanese electronics companies, has had a similar regional structure for some time. Sony Corporation of America's U.S. president is Neil Vander Dussen. Most of Sony's European units also have non-Japanese presidents.

"I think we may see a U.S. president very soon," Mitsubishi Electric's Sakurai says.

Indeed, developing the personnel they will now need to function globally is a prime concern of these newly multinational Japanese companies. The first step is an intensified effort to make their Japanese employees more international in outlook.

Canon presents a leading example of the impressive scope of some of these stepped-up personnel development efforts. Canon, like Sony, already has a reputation as one of the more international of the Japanese electronics companies. Before the high yen, the company used to get 75% or so of its revenue from exports. Now Canon's tactic is to manufacture each product in its largest market, and it expects to be doing 60% of all its production outside of Japan in 10 years.

Teaching everyone English

Canon already teaches English to its university graduates, and has an intensive, 100-hour course in international business and foreign cultures for managers being sent overseas. But now the company has decided that if it is to become a truly international company, it must extend such training to all of its employees.

The harder issue, just now being tackled by companies, is how to turn foreign managers into real Japanese company men

So now Canon has begun teaching English to its blue-collar workers so they will be able to work more closely with workers overseas, such as when they help set up the company's U.S. electronic typewriter plant this summer. Canon also plans to start putting employees not going overseas through its international training program, and it plans to greatly increase the number of Japanese employees it sends abroad, and to keep them abroad longer. Those on executive career paths will now be expected to spend 15 years overseas. In what may be the biggest step of all toward true internationalization, Canon is now letting its Australian subsidiary take charge of training the Japanese posted there in Australian business and culture.

Similarly, other companies are trying to create a workforce that can function internationally. Alps, which has only some 12,000 employees in Japan, has never considered itself a major multinational. But with its recent rapid expansion of overseas production, the company finds itself this year with more non-Japanese than Japanese employees. So it is making English the official company language, and looking hard at doing all its design documentation, technical manuals, and production manuals in English. Alps also sends 100 Japanese employees a year through its training in foreign language, foreign culture, and Japanese culture, and selects 30 to 40 of those to send overseas.

The harder issue, just now being tackled by some of the most internationally experienced companies, is how to turn foreign managers into real Japanese company men. Japanese executives are finally beginning to discuss seriously not just whether but how to integrate foreigners into the Japanese corporate leadership. This is a big step in a country where even Japanese who attend foreign universities are still somewhat suspect. One major Japanese electronics company recently made headlines for putting a foreigner in charge of a research group — although the so-called foreigner was born in Japan and graduated from the University of Tokyo; his father was not Japanese.

Many companies are sending foreign staff to Japan for short periods for training, regular corporate meetings and management seminars. Others are trying more extensive assignments: Mitsubishi Electric has sent about 100 young engineers from the United States to its semiconductor plants in Japan for nine months to a year.

Sony and NEC are at the forefront of actually assigning non-Japanese to regular jobs in Japan, in a radical attempt to develop an elite corps of foreigners with a clear understanding of the parent company. More than 75 foreigners work at Sony headquarters in Japan, and more are at the plants. An American heads Sony Video Software Co. A West German is the deputy manager of Sony's television group. Besides the 180 managers from 25 countries who have been through NEC's three-week management seminar, eight have been transferred to Japan on regular two-year assignments. The company plans to post five or six more on regular job assignments to Japan this year. □

VGA and beyond: Tough choices challenge vendors

Despite being consumed by issues of maturity — competition, distribution, pricing — vendors nonetheless must look ahead: Do you go with IBM or TI?

BY RICK WHITING

Vendors of Video Graphics Array (VGA) products for the IBM personal computer and compatible marketplace are facing some critical decisions as the VGA market rapidly matures and the battle begins for a successor graphics standard.

Manufacturers of VGA microprocessors and graphics boards are experiencing increased competition, falling prices and changes in distribution channels. But even as they struggle with an existing market that is driven by increased demand for graphics capabilities on PCs, vendors are already thinking about the future, where IBM and Texas Instruments Inc. are competing to control the next generation of products.

VGA, a VLSI graphics controller, was unveiled by IBM in April 1987 along with the PS/2 line of personal computers. Intended as a successor to the earlier Enhanced Graphics Adaptor (EGA) specification, VGA was quickly accepted by third-party vendors who rushed to bring VGA products to market.

Annual sales of EGA products peaked in 1987 at $213 million, although sales remain steady, according to International Data Corp., a market research firm. EGA is the graphics standard associated with Intel Corp.'s 80286 microprocessor, the chip used in the majority of PCs being sold today.

VGA is the graphics standard associated with 80386-based PCs. IBM and Compaq Computer Corp., whose sales efforts are focused on 80386-based PCs, are emphasizing VGA in their marketing strategies. Sales of VGA add-in products surpassed sales of EGA products in this year's first quarter, and IDC expects VGA dollar volume sales to peak in 1990 at $254 million. (IBM sells a minuscule number of add-in VGA products and components integrated into PS/2 computers are not counted in the IDC figure.)

Some vendors believe that VGA will offer growth potential beyond that. "VGA, as a standard, is probably several years away from peaking," says Robert V. Dickinson, vice president and general manager of the computer graphics unit at Western Digital Imaging in Mountain View, Calif., a business unit of Western Digital Corp. Western Digital claims that apart from IBM, it holds over 50% of the market for VGA products.

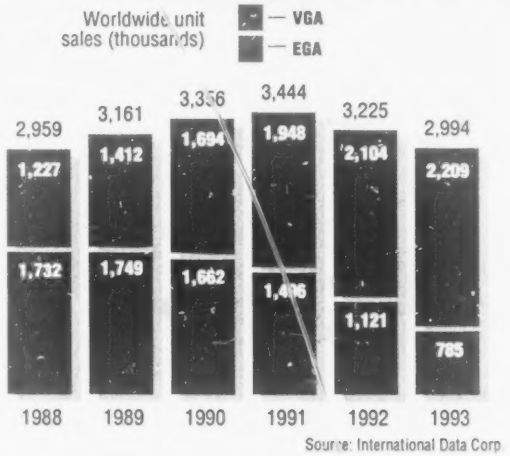
But others predict that the market could top out earlier. "I think that the VGA market has matured significantly faster than the EGA market did," says Robert Butchko, president of Renaissance GRX Inc., a Bellevue, Washington-based vendor of graphics application-specific ICs, boards and software.

VGA is being assured a longer life span by third-party vendors that have begun marketing "extended mode" products, boards and chips offering more power and higher resolution. Although 640 pixel by 480 pixel resolution is the minimum standard for PCs based on Intel's 80X86 microprocessors, vendors such as Headland Technology Inc., Fremont, Calif., are now offering VGA boards with resolution as high as 1024 pixels by 768 pixels.

The increased demand for graphics capabilities on PCs is being fueled by increasingly graphics-oriented software, such as Microsoft Corp.'s Presentation Manager user interface. "The need for color, the need for more significant graphics of all kinds, is just growing by leaps and bounds," says Butchko.

And with a huge installed base of PCs with aging graphics technology, industry watchers believe that upgrades offer a potentially lucrative market. But vendors are split on whether the majority of PC owners will migrate to EGA or VGA products. "Corporate purchasers are much better off buying VGA rather than EGA for insuring [compliance with]

EGA and VGA graphics board sales



Source: International Data Corp.

VGA is being assured a longer life span by third-party vendors that have begun marketing "extended mode" products

future standards," says Richard Brown, marketing and sales managing director at Trident Microsystems Inc., a Sunnyvale, Calif., graphics chip manufacturer.

Nevertheless, competition remains keen among vendors of VGA chips and particularly among graphics board manufacturers. "It's a crowded market," says Greg Reznick, Headland's systems marketing vice president. But industry watchers believe the number of vendors in the market has stabilized and is neither growing nor shrinking.

Despite its growth, the VGA market is not without its pitfalls. IDC projects that pricing for VGA boards will have dropped 60% between 1988 and 1993. Vendors say that prices have been falling — and profit margins eroding — in the last eight to 10 months. "There is a tremendous price erosion in the market today," says Renaissance's Butchko.

But Reznick and others attribute the sharp drop in prices to the decreasing price of DRAMs. Last year manufacturers had to boost prices because of the DRAM shortage and some vendors of EGA products were forced out of the market.

As the technology improves and multiple chipsets are reduced to one or two chips, more and more PC manufacturers are putting graphics chips directly onto the CPU board. IBM now puts VGA chips onto the CPU of its more powerful PS/2 systems and offers VGA add-in boards for low-end PS/2s and older PCs.

That means that while the OEM channel will remain strong for VGA chips, vendors of VGA boards may be forced to concentrate their sales efforts on retail channels. But Butchko says it will be about a year before the majority of VGA chips are used on CPUs, and that OEM demand for graphics boards will remain strong.

"Players in the marketplace with their own VGA chips and own low-end products are the ones that will survive," predicts Butchko. "I think you need to create your own ASICs to keep costs down to keep your margins in a real backsliding marketplace."

"Control your own silicon, because that is where the value in this market lies," agrees Western Digital's Dickinson.

Marketers of VGA products should concentrate on differentiating their wares by offering improved software, rather than simply selling products with the highest performance at the lowest price, advises Alan Lofthus, logic products director of NCR Corp.'s microelectronics division.

Dickinson also believes that the graphics arena is no longer an entrepreneurial market. He says larger companies with the resources to develop broad product lines are the ones that will succeed. Western Digital also markets graphics boards under the Paradise brand name.

A sure sign that the VGA market is maturing is the formation last April of the Video Electronics Standards Association (VESA), a consortium of graphics chip, board, and

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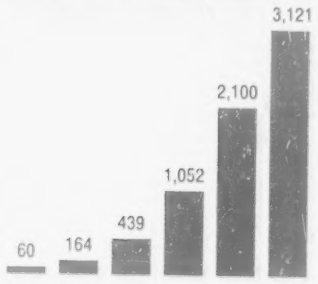
monitor manufacturers, whose goal is to establish personal computer graphics standards.

VESA has already adopted a standard software interface for 800 pixel by 600 pixel resolution in the extended VGA mode. "It's a unified approach to a de facto standard," says Larry Liang, marketing and sales senior vice president at Genoa Systems Corp., a San Jose-based marketer of graphics hardware and software.

8514/A and compatible graphics board sales

Worldwide unit sales (thousands)



Source: Dataquest Inc.

IBM compatibility, not performance, will make 8514/A-based products successful

IBM vs. Texas Instruments

Even as vendors wrestle with changes in the existing market, a struggle is already shaping up between TI and IBM over the future of PC graphics. IBM now offers add-in boards with its next-generation 8514/A graphics microprocessor for 1024 pixel by 768 pixel resolution, while TI is promoting its 34010 chip as an alternative.

Backers of the 8514/A argue that because the microprocessor is specifically designed as a graphics chip, it offers better performance than TI's competing product. Those endorsing the 34010 maintain that the chip's programmability makes it more flexible. Both sides argue that their product is more cost-effective.

"The 8514/A and TI chip is a real battle," says Butchko. Renaissance plans to debut a graphics controller this fall based on the 34010 to compete with the 8514/A and the expected wave of IBM clones.

Other vendors are throwing in their lot with the IBM graphics specification. "We think the IBM product is a clearly superior solution for the personal computer market," says Dickinson. Last month Western Digital unveiled what it claims is the first full register-level 8514/A-compatible chipset offering 1024 pixel by 768 pixel resolution, and an extended mode with 1280 pixel by 1024 pixel resolution.

Analysts believe that while the TI chip will make some gains in high-performance niche applications, most are betting that the 8514/A will gain wide acceptance. According to a report from market researcher Dataquest Inc., market share will hinge on IBM compatibility — rather than performance — and therefore it expects the 8514/A to win out.

IBM is projected to ship 150,000 8514/A-based products this year and is expected to begin adding the chip to the CPU board of high-end PS/2 models, Dataquest says. □

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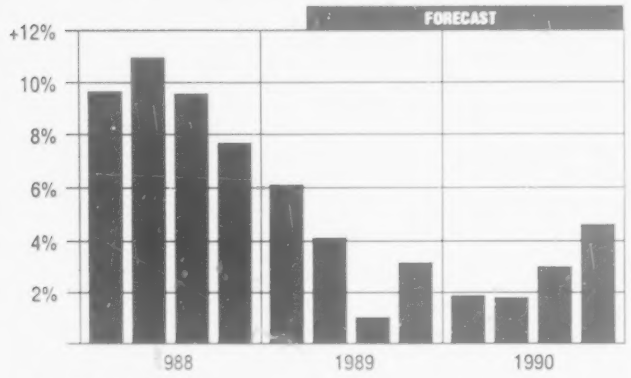
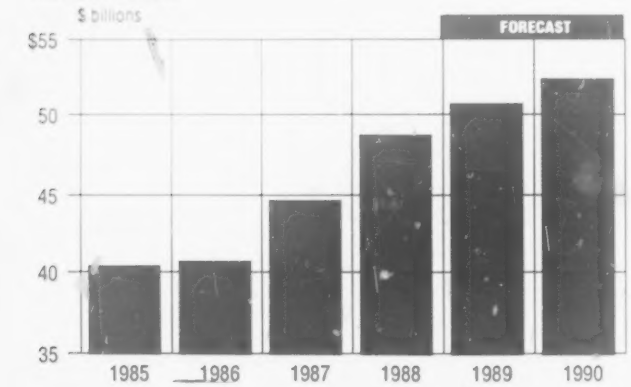
Scientific & engineering instruments shipments

Percentage change from year-ago

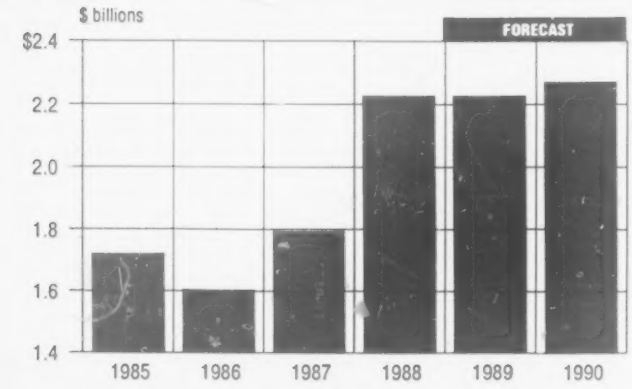


Annual totals



Data source: U.S. Commerce Department; Forecast: Cahners Economics

Worldwide ATE sales



Data source: ELECTRONIC BUSINESS; Forecast: Cahners Economics

Growth rates slow as economy weakens

From March to April, new orders for scientific and engineering instruments jumped 4.5% and shipments edged up 1.6%. Even with the one-month rise, April new orders of $4.2 billion gained just 1.5% over last April's figure, while the total of $4.1 billion in shipments actually fell just over 1% compared with April 1988.

The fact that this industry reached its business cycle peak and growth rates are slowing down has been evident for some time. Since the second quarter of 1988, the quarterly growth rate in shipments has been shrinking. In that quarter, shipments of $12.2 billion climbed 11% from the year-earlier period. The growth rate dwindled to 10% in the third quarter, 8% in the fourth quarter, and 6% in the first quarter of this year.

Cahners Economics expects this steady decline to continue through most of this year before growth rates flatten and then start heading up again in late 1990 or early 1991. Although growth is expected to decelerate, it is not forecast to be negative, so U.S. factory shipments will continue to increase. Shipments will expand by almost 4% to a annual total of $50.8 billion by the end of this year, and inch up another 3% in 1990. The preliminary outlook for 1991 is for strong gains of close to 10% in U.S. shipments as business investment picks up after a year-and-a-half lull.

The current downturn in the instruments industry will not be as jarring as the previous slump. Inventory remains under tighter control now than in the past, and backlogs, at $13.5 billion, stand 5% above a year ago. Even with the recent comeback in the dollar, foreign sales will help bolster U.S. shipments.

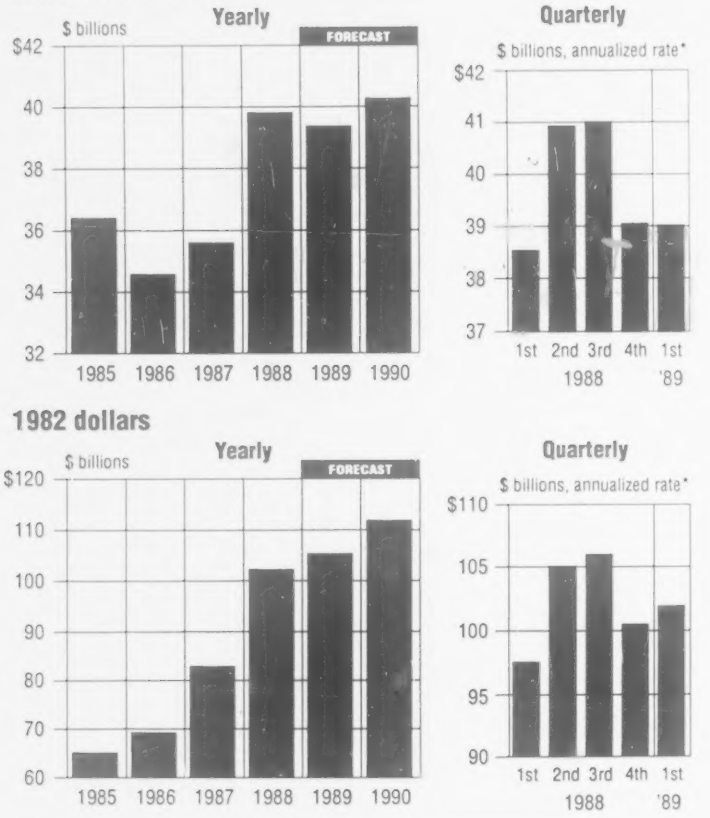
As expected, growth rates in the ATE industry turned the corner. The ELECTRONIC BUSINESS ATE sales index came in at 752.7 (1976 Q1 = 100) in the first quarter of 1989 — a 3% drop from the first quarter of last year. Growth is expected to drop off quickly so that by the end of this year ATE sales will have grown just 0.2%. That is a downward revision from the original 4% forecast as the result of a weaker than expected first-quarter performance. In dollar terms, worldwide ATE sales will amount to $2.22 billion in 1989 and $2.26 billion in 1990.

MADELINE FRANCHI

This topic is scheduled to appear again in the October 15th issue.

Business purchases of computers & office equipment

Current dollars



1982 dollars

* Seasonally adjusted

Data source: U.S. Commerce Department; Forecast: Cahners Economics

Computer buying expected to decline

In the first quarter of this year, U.S. businesses spent an annualized $39.1 billion for computers and office equipment — up 1.2% from the level in the first three months of last year. Although still above the level of a year ago, the spending pace for computers and office equipment has indeed slowed. In the second quarter of 1988, business expenditures for computer systems swelled to an annualized $41.0 billion — 18.2% above the second quarter of 1987. Since then, the year-to-year quarterly growth rate has steadily shrunk to the most recent 1.2%.

This pullback suggests both buyer uncertainty about the economy and computer standards and the fact that many businesses already upgraded their systems and won't be buying as much this year.

On a current-dollar basis, Cahners Economics forecasts about a 1.0% decline in U.S. business purchases of computers and office equipment by the end of this year. This contraction will be mild and short compared with the 1985-1986 recession.

MADELINE FRANCHI

This topic is scheduled to appear again in the October 15th issue.

Computer market database

Latest quarter: 1st quarter 1989	Latest quarter	Previous quarter	Change	Year ago	Change	Next year	Change
Industrial production (SA,1977=100, qtr. average)	336.33	322.03	+4.44%	305.33	+10.15%	324.37	-3.56%
Shipments (SA, $ millions, qtr. total)	$16,840	$16,839	+0.01%	$16,225	+3.79%	$16,650	-1.13%
New orders (SA, $ millions, qtr. total)	$16,570	$16,590	-0.12%	$16,003	+3.54%	$16,348	-1.34%
Unfilled orders (SA, $ millions, qtr. total)	$13,201	$13,471	-2.00%	$13,729	-3.85%	$12,668	-4.03%
Inventory-to-shipment ratio (SA, end of qtr.)	2.08	2.13	—	2.02	—	2.18	—
All employees (thousands, end of qtr.)	474.8	479.4	-0.96%	468.7	+1.30%	470.6	-0.89%
Production workers (thousands, end of qtr.)	155.2	156.3	-0.70%	157.5	-1.46%	150.5	-3.05%
Business purchases (current $ billions)	$13.02	$13.03	-0.08%	$12.86	+1.24%	$13.24	+1.69%
Business purchases (1982 $ billions)	$34.27	$33.49	+2.33%	$32.48	+5.51%	$35.78	+4.41%

SA = seasonally adjusted; all other data is not seasonally adjusted

Data sources: Federal Reserve Board, U.S. Bureau of the Census and U.S. Bureau of Labor Statistics
All data for SIC 357, except industrial production, SIC 357-9. Forecasts: Cahners Economics